ARCANA

OF

SCIENCE AND ART:

OR, AN

ANNUAL REGISTER

OF

USEFUL INVENTIONS AND IMPROVEMENTS, DISCOVERIES AND

NEW FACTS,

IN MECHANICS, CHEMISTRY, NATURAL HISTORY, AND SOCIAL ECONOMY,

ABRIDGED

FROM THE TRANSACTIONS OF PUBLIC SOCIETIES AND FROM OTHER SCIENTIFIC JOURNALS, BRITISH AND FOREIGN, OF THE PAST YEAR.

WITH SEVERAL ENGRAVINGS.

"Occurrences, which, according to received theories, ought not to happen, are the facts which serve as clews to new discoveries."—SIR JOHN HERSCHEL.

LONDON:
PRINTED BY AND FOR JOHN LIMBIRD, 143, STRAND.
MDCCCXXXVIII.

ADVERTISEMENT.

THE present volume will, it is hoped, be found, in novelty, interest, and general attractiveness, superior to either of the ten volumes which, by favour of the public, have preceded it. The vast periodical increase, or accumulation, in the records of science, since the publication of the first volume of ARCANA, has frequently suggested the inadequacy of our annual limit for a Register of the whole year. But this difficulty has had its compensating advantage, by enabling us, in the wealth of materials, to render each volume more *recherché* in character than its precursor.

Among the more striking novelties in the *Mechanical* section of the following pages, are the Facts, on Steam Locomotion, elicited at the late Anniversary of the British Association;* some valuable Engineering papers; Electric and Hydraulic Telegraphs; an Improvement in Wollaston's Goniometer; a New Pocket-box Circle; some very important Results of Hot and Cold Air Blasts in the Reduction of Iron; the application of Electro-magnetism as a Motive Power; and Improvements in the Manufacture of Caoutchouc.

The *Chemical* section is copious, somewhat beyond previous limit; inasmuch as it comprises the recent Researches in Voltaic Electricity and Electro-magnetism, inquiries of inestimable importance to the scientific world. Among the most prominent papers is one on the Incidental Production of Cyanide of Potassium in the manufacture of Cast Iron; M. Gay-Lussac, on the Burning of Limestone; several interesting Phenomena of Light, and Sir David Brewster's identification of the Vegetable Origin of the Diamond; a New Voltaic Battery; a Method of Analyzing Organic Compounds, and the Present State of Organic Chemistry; the Examination of the "Arsenicated Candles," meriting place in a popular work; the Congelation of Mercury by Natural Cold; the Production of Artificial Rubies; a curious Investigation of the Ashes of Plants; Mr. Crosse's own Report, *ab incepto*, of his Researches in Galvanism; and several New Processes, and Modes of preparing New Chemicals.

* Held at Liverpool, between the 11th and 16th of September, 1837.

In *Natural History*, the section *Zoology* comprises records of rare occurrences of Species; characters of New Forms; and many valuable inquiries into the Animal Economy, as the changes in the Ova of Fishes, a peculiar Structure in Shells, the Hybernation of Animals, the Growth of Polypidoms, Changes in Crustacea, the Developement of Decapodes, &c. The papers on the European Bison, the Geographical Distribution of Animals, and the Snake-like Proteus, combine popular interest with their technological value. A few pages follow, of Selections from the Proceedings of the London Zoological Society. In this department are also recorded the formation of an Ornithological Society, and the reception in this country of a Young Female Oran-Outang, whose habits and characteristic traits are cleverly detailed. In *Botany* are some newly noticed processes in Vegetable Physiology; and the discovery of a magnificent Tropical Water-lily has supplied the Frontispiece to our volume. This splendid plant has been named in honour of her Majesty; and may the cognomen prove auspicious to science.

In the section of *Geology* will be found illustrated records of the occurrence of New Fossil Organic Remains; the past year having been unusually fruitful in these relics of a former world.

Under *Astronomical and Meteorological Phenomena* are recorded the notes of several observers of the November Asteroids and Aurora Borealis; with the construction of three new Anemometers and a Rain-Gauge. Dr. Armstrong has again obligingly communicated the yearly Meteorological Summary.

In the remaining departments will be found described Heathcoat's Steam plough; Reid's Improved Hydraulic Engine; a new Boiler for Heating by Hot Water; and, by taking "time by the forelock," Dr. Arnott's Thermometer Stove, and Joyce's New Heating Process.

The Miscellanies include the customary Lists, the Obituary, and Table of Meetings.

London, March 17, 1838

CONTENTS.

ENGRAVINGS.

ARCANA OF SCIENCE,

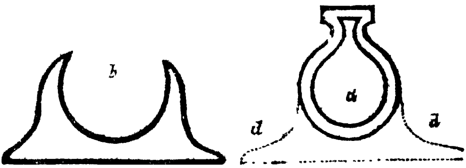
&c.

MECHANICAL AND USEFUL INVENTIONS.

RUTHVEN'S IMPROVEMENT ON IRON RAILS FOR RAILROADS

MR. RUTHVEN, of Edinburgh, has bestowed much time and labour in contriving a form of a rail which, he thinks, will be found to possess material advantages over the wrought-iron rails now in use. The subjoined figures represent a section of the rail (*fig.* 1. *a*) and the chair (*b*).

Fig. 1



The rail (*a*) consists of a tube of cast-iron, about 4 or 5 inches in diameter, and thicker below than above. At top it extends upwards, leaving a flat surface (*c*) for the wheel of the carriage. It is formed in lengths of 9 feet or more, and has a chair, marked by the dotted line *d d*, cast on it at the middle, and, of course, immovable. The chair for joining the ends of two rails is of the form *b*. Its curved interior exceeds a semicircle; so that it embraces and retains the rails without any pins.

The advantages of this invention, in Mr. Ruthven's opinion, are the following:—

1. The hollow rail (the bottom of which, it must be remembered, is one half thicker than the sides and top) is much stronger than a solid rail of the same weight and materials. 2. The tubular form is a security against its bending laterally outwards or inwards. 3. The joined ends, being embraced within the chair, are more effectually secured from springing up than in the usual

way, by pins; while the rail is prevented from rolling in its seat by the fixed chair *d d*. 4. The longitudinal contraction or expansion of the rails, by variations of temperature, is provided for by the absence of the pins, without producing any looseness. 5. He thinks cast iron might be employed in this way for rails, instead of malleable, with a great saving of expense; and it is allowed, we believe, that, except for its frangibility, cast iron is the preferable material. The form, however, is quite consistent with the use of wrought iron. He has had some lengths of the rails cast; and he has found by experiment that a yard of it, weighing 48 lb., placed with its two ends on rests, supports a weight of more than ten tons.

We think there is merit enough in these rails to deserve a trial, which could be easily made by laying a space of 20 yards with them, in some of the existing railways, where locomotive engines are used.

We mentioned some time ago, that Mr. Ruthven was erecting one of Avery's engines (an American invention), which works by the reaction of steam, without beam, crank, piston, or valve. It is now ready, and will be at work in his own premises as soon as the masonry and external parts are completed.*

The following account of Mr. Ruthven's rail has been addressed by himself to the editor of the *Scotsman*: that intelligent and scientific gentleman having, with his usual attention to every description of improvement, given the notice of it which we have just quoted.

"Having for many years devoted much attention to this important subject, it may be considered as the result of well-matured investigation; and, although it may surprise many that there should be any difficulty in deciding on the best form of rail that can be adopted, after the experience had in the various railways established both in Europe and America, yet it appears that much misconception in regard to the proper form is still entertained. For instance, the rails on the Liverpool and Manchester Railway, without being greatly varied in form, have been changed in weight from 35 lb. to 75 lb. a yard. The expense attending such a change need not be stated: this and many others are proof how far the strength and weight of rail has been considered necessary more than the form.

"It has been supposed that a proper knowledge of the strength of iron was generally known, and that nothing more was required but to increase the weight of rails, and the desired object would be attained. It may be demonstrated, however, that form is equally important as weight. All admit that a tube is much stronger than the same quantity of material in a solid body. It may also be supposed to be admitted that the rails give resistance to the carriages, or weight on them, by the tension of the metal

* Scotsman, Aug. 26, 1837.

on the under side, and compression on the upper. Many interesting experiments have been made to ascertain the relative strength of rails, and compare one kind of iron with another; but this has been done more to ascertain the proportional strength in the difference in the weight of material, than in the variety of form; for a given weight of material appears hitherto to have been more considered than the form.

"I shall now, therefore, call your attention, and those connected with this national improvement, to the interesting fact, published in your paper of the 16th inst., as having been stated at the recent meeting of the British Association in Liverpool, by Messrs. Fairbairn and Hodgkinson; viz., 'The next experiment was on castings of a T form, or resembling railway rails, which were broken with the flange both upwards and downwards. In the first experiment, with the flange downwards ⊥, the bar of cold blast iron bore a weight of 1,050 lb. They then reversed the bar's position, putting the rib downwards T, and the bar broke with a weight of only 266 lb.; so that there was a great difference, and this was of great importance in reference to the shape of rails, beams, &c., for bearing heavy weights.' This is certainly too important to be passed over without particular notice, and is the point to which I wish to call attention. The rail proposed by me is tubular; and, being laid horizontal, increased strength is gained by increase of thickness on the under side of the tube, producing similar effect to the above ⊥ bar, which in this position made a difference of strength in the ratio of 1,050 to 266 over the former T. But the improvement in strength is made greatly more than the ⊥ form, by continuing the flange, until it meet the bar at the upper side on which the wheels run, as shown in *fig* 2; for a rail weighing 48 lb., in this form, is able to sustain, without fracture, a pressure of upwards of ten tons bearing on the centre of it. By this circular or tubular form, in addition to general strength, the rail is secured against side deflection, which takes place in the rail at present in use, destroying the power employed, and the rail itself to a great extent, and is generally the cause of a carriage running off the railway.

Fig. 2.

"This, then, may be considered as two important objects gained; that of strength with less materials, and avoiding deflection both vertical and horizontal. The chair at the joinings is the next point to call attention to. The hollow rail being circular, the chair is formed to embrace more than half of the tube, as illustrated by the diagram given in your paper of the 26th ult., which most effectually secures the rail from rising, or, indeed, every motion (except expansion or contraction), merely by the form, which supersedes the necessity of locking or keying as hitherto, and avoiding the disagreeable shake in passing over the joinings of the rails; this, therefore, may be stated as a third improvement; as a fourth, the saving of expense, which

will be found, *cæteris paribus*, to be greatly less than those at present in use. I have it not in my power to make these rails on a great scale; but I have some yards ready to exhibit to the public, and shall be happy to give every information desired to those who may consider it deserving their attention.*

MEDAL-STRIKING.

We have much pleasure in announcing to the friends of the fine arts that Mr. Pistrucci, chief medallist in the Royal Mint, has discovered a method by which he can stamp a matrix or a punch from a die which has never been touched by an engraver, and shall yet make the medal identically the same with the original model in wax, an operation by which the beauty and perfection of the master's design are at once transferred to any metal, whether gold, silver, or copper, by striking it according to the usual process. It will at once be seen that this is a very different operation from that by which cast medals are manufactured. It is as simple as it is ingenious: and Mr. Pistrucci having no intention of taking out a patent for the discovery, and being anxious to give to the public the full benefit of it, in the different processes of manufacturing plate, jewellery, and all kinds of ornamental work in metal, announces that the whole of the process consists of the following method:—The model being made in any substance, wax, clay, wood, or other fit material, a mould of it is taken in plaster, from which mould, when dried and oiled to harden it, an impression is taken in sand, or other similar substance which may be preferred, and from this again a cast is obtained in iron as thin as possible, that the work may come up sharply, and the iron attain the hardness almost of a steel die hardened. This cast-iron impression is then flattened mathematically true on the back, and fixed in a steel die, the hollow of which is turned to the exact size of the cast iron, and it is set within the rim or border, hammered as close as possible, so as to form a collar. The metal upon which the impression is to be struck, (to form either the medal itself or a steel matrix, if desired,) is to be fashioned into the shape of a cone in the ordinary way, perfectly flat at the base, heated red hot, and placed at the bottom dish of the press. When the die, fitted as above, having been previously placed at the top dish, and the workmen quite ready to give the blows instantly, three or four, as may be required, a perfect impression of the cast-iron will be attained without the least injury to it. Of course it will be necessary, previous to the die being used, for the artist to polish the surface. Mr. Pistrucci's first experiment was successfully performed upon a punch of hard copper, with his model of the medal of Sir Gilbert Blane, being nearly three inches in dia-

* Scotsman, Sept. 23, 1837; quoted in the Architectural Magazine, No. 46.

meter; and he has no doubt that it will equally succeed on a steel punch, perhaps, too, without its being necessary to heat it. When the process above described shall have been brought to the perfection of which it is capable, there can be no doubt that in the execution of works of this description it will not only be the saving of the labour of months or years in the engraving of dies, and, consequently, of great expense, but the work to be executed will in all points be, in an instant, an exact fac-simile of the original conception of the artist, instead of representing, as at present, merely the handiwork of the engraver, copied from such original. It will also dispense with the use of the very expensive machinery, such as the *tour a portrait*, introduced into the Mint by Mr Pistrucci several years ago, which, however apparently correct in its productions, can never give a perfectly true semblance of the original, even to the limited extent to which it is applicable. And we may possibly be led by it to discover the mode by which the artists of antiquity succeeded in producing those beautiful coins, in which the softness and boldness of the fleshy parts have never yet been equalled by any modern engraver in steel.*

NEW SAFETY COACH.

THE *Literary Gazette*, No. 745, six years ago, noticed in terms of commendation, the scientific principle upon which this safety coach, as it is appropriately called, is constructed. At that time, a well-executed model was exhibited in what was then denominated the National Repository, Charing Cross; and so impressed were the directors of that institution with the excellence of the invention, that they placed it first in the catalogue. Since that period, a full-sized stage coach, on the same principle, was built at the suggestion of the post office authorities, to test by experiments the alleged safety of the vehicle. However, as is the fate of too many praiseworthy inventions at the beginning, Mr. Stafford, the patentee, did not meet with that patronage from the public which he had a right to expect. Thoroughly convinced of the incontrovertible principle of his patent, the inventor continued improving it, and, finally, assisted by two scientific gentlemen, actuated chiefly by a regard for human life and limb, another coach has been built by a London maker, and in November last started on an experimental trip to Blackheath. The coach was drawn by four spirited gray horses, and dashed along at the rate of fourteen miles an hour, with eighteen literary and scientific gentlemen as passengers, besides half a ton of lading on the roof. At this furious rate it was driven sometimes with the off wheels on the embankments at the road sides, and the near wheels

* Correspondent of the Times; quoted in the Athenæum, No. 512.

working in the drain; yet the vehicle swerved so little, that the inside passengers were insensible of the slightest departure from the usual position. At Blackheath the experiments were absolutely frightful to the spectators; so much so that those not in the secret exclaimed that the coachman was mad, and wished to destroy both coach and passengers. The four horses were made to gallop over an abrupt eminence, two feet ten inches high: the coach described an angle of forty-five degrees with the near wheels, the off wheels being at the moment at the base: and thus, poised between heaven and earth, it maintained almost a perfect equilibrium. Now, it ought to be stated, that an eminence of six inches has, thousands of times, overturned ordinary stage coaches. Many other tests were resorted to; and all present declared that the triumph was complete. The vehicle is built on the plan of the mail and stage-coaches: but, instead of the usual springs being placed beneath the body, and consequently below the centre of gravity, which always renders a coach liable to overturn from inequalities in the road, the body of this carriage is suspended considerably above the centre of gravitation, even when loaded with its full complement. This is effected by two upright supporters, rising from the beds and axles, and passing up between the body and the boots. The tops of these supporters are surmounted by double elliptic springs, to which is affixed one half of the shifting centre of gravity; the other half is attached to the body.*

WATCH STATISTICS.

Mr. Dent, (Arnold and Dent,) in his illustrations of a lecture on the construction of watches and chronometers, lately given by him at the Royal Institution, laid before the meeting the dissection of a detached lever watch, (compensation-balance), every part was separated and displayed, but grouped in one of six larger divisions to which it belonged.

Each part had been previously examined, and its distinct constituent pieces counted by the lecturer; the surprising result of this enumeration was exhibited in a table, of which we lay a copy before our readers. In addition, will be found the number of kinds of artificers concerned in the operations necessary for the construction of a good watch. When to these are added the amount of previous operations which the materials constituting each piece must undergo, *before* it comes into the hands of the watch-artificer, a glimpse may be obtained of the extensive and numerous changes of form and value which "raw material" receives in its progress, from the mine to so refined a manufacture as a finished watch.

* Literary Gazette, No. 1086.

No. of Parts.	No of Pieces.		Trades employed.
1. Pillars	4	—	1
2 Frame	4	—	1
3. Cock and Potence	2	—	1
4. Barrel and Arbor	3	—	1
5. Going-Fuzee	14	—	2
6. Wheels	4	—	1
7 Pinions	4	—	2
8. Stop-Stud	1		1
9. Stop and Spring	3	—	1
10 Click and Ratchet	3	—	1
11. Motion	16	—	2
12 Jewels, (5 holes)	28	—	2
13. Cap	3	—	2
14 Dial	5	—	3
15 Index	1	—	1
16. Escapement	13	-	3
17. Compensation-Balance	9	—	1
18 Case	3	—	1
19 Pendant	2	-	1
20. Case-Joint	6	—	1
21 Case-Spring, &c	4	—	2
22 Main-Spring	1		2
23. Chain	826	—	3
24 Hands	3	-	1
25 Glass	1		1
Total of Pieces	992		
Engine-Turner			1
Engraver			1
Gilder			1
Examiner			1
Total of kinds of Artificers employed			43*

STEAM NAVIGATION.

Among the most interesting of the subjects brought before the British Association at their last meeting, were the *Motion of Steam Vessels in shallow Water*, the phenomena attending it, and the effect of peculiarities in the construction of channels and embankments, on all of which Mr. Russell, of Edinburgh, afforded much valuable information.

The first paper brought forward by him was on the *Mechanism of Waves, in relation to Steam Vessels in shallow water*, in which he gave the practical application of the series of experiments which he had made on this subject. It was found, that in rivers, steam-navigation was exposed to much greater disadvantages than in the open sea. These disadvantages arose from three causes; 1st, From the great wave of anterior translation; 2dly, From the formation of lateral currents, and 3dly,

* Magazine of Popular Science, No. 16.

From the stern wave, or posterior surge. The first of these, the great anterior wave of translation of the displaced fluid, reached to the full depth with equal velocity, and was generated by the heaping of the water on the side of the vessel, produced by the increase in the velocity of propulsion. Its velocity was equal to the fall of a stone through half the depth, and it sometimes extended for a mile and a half, increasing very considerably the depth of the water, and the resistance to the progress of the vessel, which was doubly impeded by the anterior wave and the stern depression. This wave was to be diminished, not by widening, but by deepening the channel, and by making the difference between the velocity of the vessel and that of the wave as great as possible. The formation of lateral currents, having the same direction with the motion of the paddles, and therefore greatly diminishing their power, was the next evil. This and that arising from the posterior surge, were to be remedied by deepening the channel, and making its sides as vertical as possible, the rectangular form of channel being in every respect preferable. There was another wave, which Mr. R. termed that of unequal displacement, which diverged from the bow towards the stern of the vessel on both sides; and this was to be remedied by sharpening out the vessel towards the bow, so that her lines of displacement should be slightly concave. Mr. Russell's form for a vessel, at least so far as regarded the remedy for the evils he mentioned, would be one with a long sweeping concavity towards the bow, having the maximum breadth amidships, and a convex sweep thence to the stern.

The second paper given by Mr. Russell, was on *Tides and Tidal Waves in Rivers*, it being of great importance to determine the means by which the tide might be brought up most rapidly and furthest, and retained longest. The velocity of the tidal wave was similar to that of the anterior wave before spoken of, and it was therefore increased in the same way by deepening the channel. The shape of the banks had, with respect to it as to the other, a material influence, the velocity being increased fully one-third, by adopting vertical, in preference to sloping banks; next, with regard to the bends of rivers—the tidal wave might be made to move in any given curve by deepening the channel at the exterior side in a given ratio with the interior. The effect of these curves would be double: first, to admit the tide as rapidly as possible, and secondly, to retain it to the longest possible period. The tide might also be brought higher in a river by gradually narrowing the channel from a wide mouth. It was of importance too, to prevent the formation of tidal bores, or large waves, which sometimes rose to a great height, so as to swamp all the smaller shipping. These bores were found where the water was not of great depth, and as they could not exist, unless the depth of the water was less than their own height, the simple and effectual remedy for them was found in deepening the bed of the channel.

Mr. Russell's third paper, on *Sea Walls and Embankments*, was intended as a sequel to the two preceding. The object of such walls was to resist the secondary wave of the sea, which might be made to break at any given point, by placing a solid body below it so as to make the depth of the water only equal to its height. Several forms of embankments had been tried, the vertical, the inclined plane, and the concave; but he recommended the convex curve or a parabolic form, the slopes increasing as the squares of the distances, so that the wave being gradually broken on it, might have its velocity reduced to nothing, when it reached the summit. The vertical wall had a double duty to perform, having to

reflect the waves, as well as stop their progress, and the effect of this reflection was to make the water near the embankment alternately smooth and rough, so as greatly to endanger small vessels.*

NEW MECHANICAL INSTRUMENTS.

AMONG the new Mechanical Instruments submitted to the British Association at their last meeting were the following:—

A communication was laid before the section on a *Railway Balance Lock*, by Mr. Remington, which was proposed to effect on railways what was now done by tunnels and inclined planes, and what in canals is accomplished by locks, the trains being raised on platforms by a series of levers to any required height, and the power being supplied by a stationary steam-engine, moving platforms on each side.

Mr Hawkins exhibited a beautiful *Bust*, copied from the antique, completely finished by a machine, a drawing of which he made for the Section. In a fixed stand were placed the chisel, and at a given distance above it a wooden chisel of the same length. Towards this stand were moved two cages, one above the other, that opposite to the wooden chisel containing the original bust, and the lower cage the marble block; these cages were capable of almost universal motion, so that the block could be applied in every part to the graver, which could never penetrate too far, being regulated by the wooden chisel above. The specimen exhibited was exceedingly beautiful.

Mr. Ettrick showed an instrument for obtaining an *Artificial Horizon at Sea*.

Mr. Willis communicated a very simple and certain method of making the *Teeth of Wheels* work each other truly by taking two pitch lines, and a tracing circle of a diameter not greater than that of the smallest wheel of the set, and tracing an external epicycloid on the driving, and an internal one on the driven wheel, by which the curves would move each other exactly.

Lieutenant Watson made some observations on the use of a *Telegraph* applied to railways, for which he was about to take out a patent.

Mr. Hawkins exhibited an instrument for measuring exactly the distance between the eyes, with a view to the *exact construction of Spectacles*, and remarked on the great difference frequently observable in the focal lengths of the eyes of the same individual. Dr. Lardner mentioned a curious fact with regard to Professor Airy's having discovered that his eyes were spheroidical, not spherical, and his having suited himself with glasses on this principle.

Under the head of MISCELLANEOUS APPLICATION OF MECHANICAL SCIENCE, comes first Mr. West's paper on the *Ventilation of Tunnels*, tending to show, by a series of experiments, the results of which were given, that the usual opinion with regard to the great difference in the temperature of tunnels, as compared with the external atmosphere, was unfounded, and that shafts had little, if any effect, in altering the temperature, the air, according to Mr. West's experiments, escaping up the shaft, so that a close tunnel might be even preferable.

Mr. Lang communicated a very useful method of preserving vessels

* Magazine of Popular Science, No. 21.

from serious injury from the *loss of their keel on rocks.* His plan was to have two false keels with a solid bottom, and to caulk with Borodaile's patent felt, so that both keels might be knocked off without the leakage of a single drop of water. Mr. Lang instanced several cases, where, under the severest trials, this plan had been completely successful.

Mr. T. Taylor read a report on *Printing in raised characters for the Blind*, in which the Roman letters, without any abbreviations or arbitrary characters, were strongly recommended, in preference to any methods hitherto proposed. Blind children were enabled by them to read with about half the rapidity of ordinary readers. Different specimens of printing were exhibited to the section, and Mr. Alston's, of Glasgow, (the one recommended), appeared to us decidedly preferable to any of the others.

Mr. Williams, of the City of Dublin Steam Navigation Company, described a very simple method lately adopted in their vessels for *Preventing Danger from Collision or Fire.* It consisted in dividing the vessel into five compartments by four water-proof iron bulk-heads, fitted with patent felt into the sides of the vessel, which were made, in those parts, solid for the purpose. Any of these compartments, and even three of them together, might have the water admitted to them without at all endangering the safety of the passengers or the vessel, so that in a case of collision, the injury would be merely local, and, in case of fire, the water might be freely admitted to the part where it originated, while there would be no general current of air underneath, and little danger of the fire spreading.*

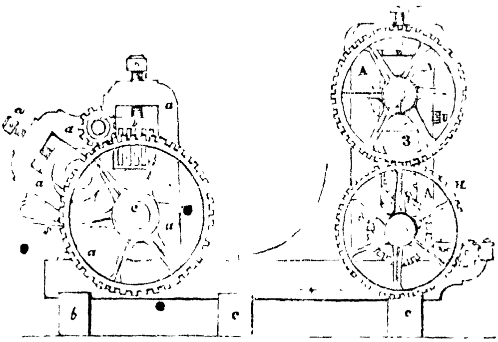
CAOUTCHOUC MACHINE.

Mr. John Pickersgill, of Coleman-street, London, has patented the following improvements in preparing and applying India-Rubber, (Caoutchouc), to various Fabrics.

According to the ordinary modes of making water and air proof fabrics, by the aid of India-rubber, (caoutchouc,) whether laid in a thin layer or coating, on one side of a fabric, or a surface of India-rubber, between two thicknesses of fabric, the same has been performed by dissolving India-rubber, by means of coal or other chemical solvents, which bringing the India-rubber into a fluid state, it is spread over the fabric, to be rendered water-proof; and when the same is intended to be a layer of India-rubber, between two surfaces of fabric, the fabrics being covered by a brush or similar means, with dissolved India-rubber, are stuck together by pressure. The material used as a solvent, being then evaporated, leaves the India rubber adhering to the surface of the fabric, when a single fabric is used, or the dissolved India-rubber is the means of sticking two surfaces of fabric together, in either case rendering the fabrics water and air proof. Now, the object of the invention is, First, the preparing India-rubber by pressing or rolling it into thin sheets, and applying them to the surfaces of fabrics, that the same may be rendered

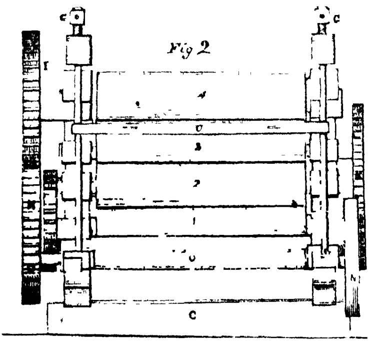
* Magazine of Popular Science, No. 21.

air and water proof, without the aid of solvents, and without the necessity of bringing the India-rubber into a state of fluidity. And, Secondly, the invention relates to the application of lamp-black, or other colouring matter, to the India-rubber, when the same is spread over only one surface of a fabric, without the aid of solvents to render it fluid, whereby the surface so prepared may be rendered of a dark or black, or other colour, and thus producing an even glossy surface, the sticking properties of the India-rubber being thereby prevented, whereby single fabrics so prepared, may be used for a variety of purposes, without covering or lining.



(Fig. 1)

In Figs. 1 and 2, the same letters are used to indicate similar parts. Fig. 1 represents a side view in elevation of the machine. Fig. 2, is an end view of that part of the machinery, which prepares and presses the sheet of India-rubber, (caoutchouc,) on to the surfaces of fabrics, or between two fabrics.



A, A, is framing. B, is a brace or tie, connecting the two parts of the frame together. C, C, are two timbers upon which the frame stands. Nos. 1, 2, 3, and 4, are iron cylinders. At the back are five bars or checks, through which the cloth passes, before it enters between the rollers; a roller upon which the cloth is wound before being coated; and a check weight attached to a friction cord, passing over another roller.

G, g, are screws for regulating the pressure of the rollers or cylinders, Nos. 1, 2, 3, and 4. H, is a cog-wheel, that drives the cylinder, No. I. I, is a cog-wheel attached to the axle of the cylinder, No. 4, and is driven by the wheel H. K, is a cog-wheel, attached to the axle of the cylinder, No. 3. There is a cog-wheel upon the axle of the roller, No. 1. There is a pinion taking into the wheels, K and L, and serves to give the proper direction to the wheel, K, L, being the driving wheel, N, is a pulley, or drum, attached to the roll or shaft, O, seen in fig. 2; the shaft having a pinion upon its other end, which drives the cog-wheel, H. The cloth passes between the cylinders, Nos. 2 and 3; at S, is seen a sheet of India-rubber, which comes in contact with the cloth, whilst passing between the cylinders, Nos. 2 and 3. A roller is driven by a short belt, or strap, from the shaft, O. There is a small roller, upon which the cloth is wound, when it leaves the cylinder, No. 1. Between the cog-wheel H, and the frame A, is a cog-wheel, upon the cylinder, No. 1, and also upon the cylinder, No. 2; the wheels being the same size as the cylinders to which they respectively belong. That upon No. 1, drives the one upon No. 2, and consequently the cylinder, No, 2; U is a hopper, into which the prepared rubber is put, while hot, as it comes from the preparing apparatus, or machinery. When three rollers only are used, the hopper is put upon the opposite side of the cylinder, between Nos. 2 and 3. The ends of the hopper are capable of adjustment, in order to make the hopper an inch or two inches less than the width of the fabric to be coated, and the hot mass of India-rubber is spread from end to end of the hopper. *a, a, a*, is a frame of cast-iron of the preparing machine. *b, b*, are timbers upon which the frame rests. *c*, is a larger cylinder, six feet long and twenty-seven inches diameter. There is also a cylinder, six feet long and eighteen inches in diameter; and *e*, is a shaft, six inches in diameter. *m*, is a pinion upon the shaft, *e*, which drives the cog-wheel, *k*, and consequently the cylinder, *c*, the pressure upon which is regulated by bars of iron and screws; *s*, is an endless cloth, which carries the rubber to be prepared between the cylinders.

It will be seen on examination of the wheels or gearing of one cylinder or roller, Nos. 1, 2, 3, and 4, with the other, that they are so arranged as to produce a rolling and sliding motion to the surfaces, which will be found to be very useful in the operation to be performed.

The India-rubber is first cut into pieces of about two inches square, and about a quarter to an eighth of an inch thick. It is spread on the endless cloth, *s*, which conveys it to the cylinder *c*, where the compound rolling and pressing and sliding action of the heated cylinder, softens and tears the India-rubber into fine threads or thin sheets. Thus it passes all the bars successively, and undergoes this operation several times before it goes from this machinery to that part of the machinery which is for the purpose of rolling or pressing down the India-rubber into a thin sheet, and for pressing it on to the surface or surfaces of a fabric or fabrics. The India-rubber is brought to a combined mass by the operation of the cylinders, *c*, and the bars, and the whole is so combined and in a warm state, as to readily allow of being rolled into thin sheets.

In the event of the India-rubber being only placed on one fabric, then it becomes desirable to prevent the sticky property of the India-rubber, in order that fabrics so prepared, may be made up into various articles of dress, or for other purposes. In order to perform this part of the process, colouring matter, such for instance as lamp black in the state of

dry powder, is to be sifted between the bars, amongst the India-rubber, which will become mixed with it, by repeatedly passing the same through and through the preparing part of the machinery. The product from the preparing machinery, (whether India-rubber or India-rubber mixed with colouring matter,) is then taken to the hopper, U, where the revolution of the cylinders, Nos. 4 and 3, will press out the India-rubber into a thin sheet, which, passing partly around the roller or cylinder, No. 3, will come in contact with the fabric which has been previously conducted to meet it. The India-rubber, and the fabric will then pass between Nos. 3 and 2, and thence between Nos. 2 and 1, by which the India-rubber, or preparation thereof with colouring matter, will be pressed together and so closely combined as to appear one fabric. The machine here shown is only intended for laying a surface of India-rubber on one surface of fabric, but if it be desired to press a thin sheet of India-rubber between two fabrics, in that case, a second fabric may be brought in the direction of the dotted line, and meet the India-rubber between the cylinders, Nos. 2 and 1 It should be stated that the cylinders, Nos. 1, 2, 3, and 4, are hollow and are to be mounted on hollow axles with suitable connexions which are well understood by engineers, and will readily be applied, and which are omitted in the drawing to prevent complexity. The cylinders, Nos. 1, 2, 3, and 4, are to be heated with water or steam to about 200 of Fahrenheit, and the cylinder, *c*, is to be hollow and is also to be heated to a like temperature, but it will sometimes be found that the friction of India-rubber dragging on the surface will raise the temperature to that degree, that the India-rubber will stick to the surface; in such case the cylinders are to be cooled down by allowing cold water to pass into the same, till the temperature is reduced to such a degree as to allow of working with facility.

The patentee then claims, First, preparing by pressing and rolling out thin sheets of India-rubber, and pressing the same on to one or between two fabrics for the purpose of making fabrics, water and air-proof.

And, Secondly, the application of colouring matter to India-rubber so prepared when applied and pressed into one surface of fabrics, for removing the sticking properties of the India-rubber, and for colouring the same. But he does not claim the mixing of colours with India-rubber, when the same is dissolved or when used for other purposes.

Mr. Pickersgill's patent will be found at length in the *Repertory*, No. 42, illustrated with six diagrams, two only of which we have adopted in the above abridged description.*

PAPER-MAKING.

On April 11, at a meeting of the Society of Arts, Mr. E. Cowper delivered an interesting lecture on recent improvements in paper-making. He referred to the origin of paper-making, and to the various plants, (drawings of which he exhibited,) from which it had been manufactured. Speaking of the strength of writing papers, he produced a sheet of post quarto, the ends of which he had pasted together, and he raised half a hundred weight with it. The same sheet, he said, had lifted a man off the ground. He then adverted to Mr. Babbage's experiments, for ascertaining

* Abridged from the Repertory of Patent Inventions, No. 42.

the colour of paper least injurious to the sight, which he stated to be green; though, in printing papers, the type was never more effective than when used on white. He explained the nature of the machinery used in the manufacture of the article, and observed that, though objections had been urged against it on its first introduction, it would now be impossible to produce the required supply by manual labour. He showed the construction of the frame used for making wove paper, and perfected two sheets in the presence of the Society. In his observations on the length of paper which had been manufactured, he mentioned that one sheet had been completed which would reach four miles; and that an eminent manufacturer, whose mills were visited by the Duke and Duchess of Sutherland, had a sheet made to cover the lane they had to pass, from the proprietor's residence to the works, of at least three quarters of a mile, and which answered all the purposes of a carpet. He mentioned, that in the early attempts to manufacture the articles, a petition had been presented by the proprietors of mills at Rome to the Pope, praying that some means might be devised to turn their stock into more advantageous property, their warehouses being full, while the manufacturers were absolutely in want of the necessaries of life;—and, added Mr. Cowper, the amazing stock referred to was equal to the consumption of about three of our Penny Magazines. Respecting glossy papers, he observed, if they were too dry, they would crumble into dust; and he particularly eulogized Mr. Dickenson's improvements in paper-making.*

INSTITUTION OF CIVIL ENGINEERS.

THE Council has given out the following subjects for communications and premiums for the Session of 1838, which commences the 9th of January:—

1. The nature and properties of steam, considered with reference to its application as a moving power for machinery.
2. The warming and ventilation of public buildings and apartments, with an account of the methods which have been employed most successfully for ensuring a healthy state of the atmosphere.
3. An account and drawings of the original construction and present state of the Plymouth breakwater.
4. The ratio from actual experiment of the velocity, load, and power, of locomotive engines on railways: 1st. Upon levels; 2nd. Upon inclined planes.
5. Drawings, description, and account of the principles of Huddart's rope machinery at Limehouse.
6. Sewerage of Westminster.
7. Drawings and description of the shield of the Thames tunnel, with an accurate account of the method by which it is advanced and worked.†

* Athenæum, No. 494. † Railway Magazine, No. 21.

SOCIETY OF ARTS.

On June 12, the annual distribution of the rewards given by this Society took place at the Hanover-square Rooms. His Grace the Duke of Sutherland presided. Eighty-five rewards were distributed:—of these, twenty-two were in the class Mechanics, and other practical arts; eight in the Fine Arts—amateurs' copies; ten for original; a like number for artists' copies; and thirty-five for originals. Fifteen of the successful competitors were young ladies. The following is the list in Mechanics; and we may here remark, that those distinguished by asterisks are considered the most important:—

* To Mr. James Ryan, 59, Hare-street, Bethnal-green, for his instrument for drying silk in the loom, the silver Isis medal and five pounds.

To Mr. William Webb, 26, Wood-street, Spitalfields, and to Mr. George East, 5, Turner's-square, Hoxton New Town, for their improved Jacquard machine for weaving figured velvets, two silver Isis medals.

To Mr. Henry Chapman, of the Royal Dockyard, Woolwich, for his improved cross-tree for ships of war, the silver medal.

* To Mr. J. Brown, Corkbeg-Cloyne, for his dredging machine, five pounds.

* To Mr. James Marsh, of the Royal Arsenal, Woolwich, for his percussion tubes for ships' cannon, the silver medal.

* To Mr. J. Kingston, of the Royal Dockyard, Woolwich, for his blow-off pipe for marine steam-engines, the silver medal.

To Mr. Isaac Dodds, Masbro' near Rotherham, for his safe-plug for a steam boiler, the silver medal.

To the same, for his cast-iron wheel for locomotive carriages, the silver medal.

To Mr. G. A. Patterson, 21, Coppice-row, Clerkenwell, for his repeating motion for a quarter clock, the silver medal and ten pounds.

To the same, for his vertical escapement for pocket watches, five pounds.

To Mr. H. Mapple, 69, Red Lion-street, Clerkenwell, for his escapement for timepieces, five pounds.

To Mr. T. Cole, 23, Upper King-street, Bloomsbury, for his clock escapement and self-adjusting pendulum, the silver medal.

To Messrs. C. and J. Mac Dowall, 21, Church-street, Kensington, for their centripetal dial-plate for clocks, the silver Isis medal.

To W. Talbot Agar, Esq., Elm Lodge, Camden Town, for his instrument for turning over the leaves of a music-book, the silver Isis medal.

To Edward Mammatt, Esq., Ashy-de-la-Zouch, for his writing apparatus for the use of the blind, the silver medal.

To Mr. W. Juggins, 22, James-street, Covent-garden, for his scale-weights of porcelain, the silver Isis medal.

To Mr. James Sperring, Duke-street, Bloomsbury, for his method of inclosing sliding-doors, the silver Isis medal.

To Mr. Charles Arundel, 8, Great Mitchel-street, St. Luke's, for his improved router, the silver Isis medal.

* To Mr. Andrew Ross, 15, St. John's-square, for his adjusting object-glass for a compound achromatic microscope, the gold Isis medal.

* To Mr. T. Slacks, Langholm, for his method of building an obelisk without scaffolding, the gold Isis Medal.

* To Mr. Richard Jones, 75, Leman-street, for his improvement in the apparatus for raising and lowering the diving-bell, the silver medal.*

BUILDING UNDER WATER.

Mr. William Bush, of Wormwood-street, London, surveyor and engineer, has patented the following for improvements in the apparatus for building and working under water.

This invention relates, *First*, to the means and apparatus for building or constructing the foundations of light-houses and other buildings below the surface of the water; *Secondly*, in the mode of supplying air to diving-bells; and, *Thirdly*, in the mode of supplying air to persons working under water by the aid of diving-dresses; which improvements are also applicable for descending under water for various purposes, such, for instance, as the examination and ascertaining the position of objects below the surface of the water: and also by the application of an air-belt to diving-dresses to facilitate the rising of the diver or regulate his descent; and, further, in the application of a compass within the helmet of a diving-dress, by which means the diver may see in which direction he is moving, and thus ascertain the position of any object below the water.

The first part of the invention relates to building light-houses by conical framing of wood, shod with iron, and connected with iron caps and bolts.

The patentee then proceeds to describe the manner of using the apparatus. Supposing it is determined to have three cones for the constructing the foundation of a particular light-house; the cones being prepared and joined, are to be lowered, and the shod part will penetrate the sand to a considerable depth; and the lower part of the cone will, when the water is pumped out, form a water-joint, and for the most part prevent the water penetrating to the interior of the cone. The inner surface is then to be filled with masonry of granite to the height required, and on this foundation is to be built the light-house. But, as the invention relates only to the mode of combining and using the double cones or conical frames, and as the means of laying the masonry and the mode of constructing light-houses forms no part of the invention, no further description will be required, they being well understood. The foundation of the light-house being built, the cones may then be removed; and in order to facilitate this operation, the hoops which bring the parts of the cones together are each made of two or more pieces, combined by bolts and keys, which being removed, will allow of the parts of the cones separating and floating; and in order to accomplish this, divers in diving-dresses descend, and first remove the keys of the hoops, and of the flanges of the external cone, by which each part of that cone will separate, and the sand filled into the space will fall away from the inner cone, and allow of the keys of the hoops and flanges being got at and removed.

The second part of the invention consists in applying one or more pumps within a diving-bell, in order that the workmen descending therein may keep up the necessary supply of air for their use, in place of having

* The Literary Gazette, No. 1065.

Fig. 1.

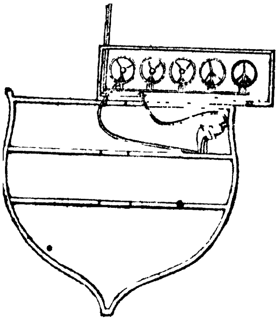


Fig. 3.

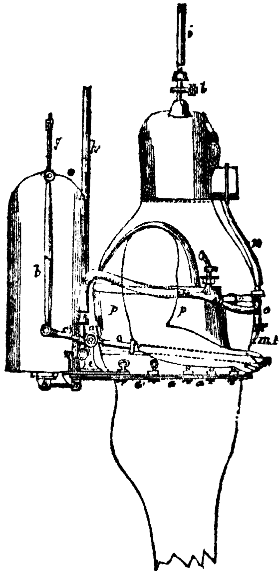


Fig. 2.

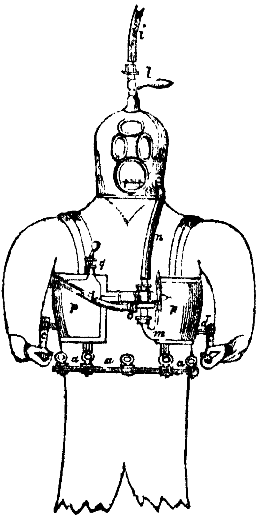
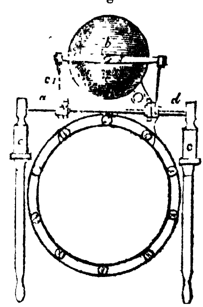


Fig. 4.



the air forced down, from above as heretofore practised. In order to accomplish this part of the invention, one or more pumps are fixed in connexion with an air-pipe, which is to be supported above the water's surface; and it is recommended that two, three, or more air-pumps, should be used in the bell and connected to the air-pipe, so that in case either pumps should get out of order, there will always be one or more to keep up the supply of air.

Fig. 1, shows a sketch of this part of the invention.

The third part of the invention consists in combining a pump with a diving-dress or helmet, whereby *the diver can at all times*, by working the pump, obtain a fresh supply of air from *above*; *and in order to render* the constant operation of pumping unnecessary, the pump is inclosed *in* an air-tight vessel or receiver, into which the air enters from the pump; consequently, by filling this vessel occasionally, the diver may perform the work for which he descends, or make such examination of objects below the surface of the water as may be desired.

Fig. 2, shows a front view.—Fig. 3, a side view; and,

Fig. 4, a plan of apparatus, having the improvements applied thereto; the outline representing a man in a water-tight diving-dress and helmet, which is of two parts, jacket with helmet and trousers combined by the hoops, *a*, *a*, and screws, as is clearly shown in the woodcuts: *b*, is an air-tight vessel of copper, or other suitable material containing an air pump *c*, *c*, are handles moving on an axis, at *d*, *d*, which are supported by the standards, *e*, *e*, affixed to the plate or bottom of the air-vessel, as is clearly shown: *f*, *f*, are two connecting-rods attached at one end by pin-joints to the levers, *c*[1], *c*[1], affixed to the axis, *d*, and the connecting-rods are attached at their other ends by pin-joints to the curved cross head, *g*, the cross head being affixed to the piston-rod of the air-pump, which rod works through a stuffing-box formed on the upper part of the air-vessel. By this means the pump within may be worked by the diver when below the water: *h*, is a waterproof flexible pipe, being kept to its figure by a spiral coil of wire, as is well understood. This pipe, *h*, is the air-supply pipe, the upper part of which is kept above the water's surface by a buoy, or other suitable means; and such is the case with respect to the exit-pipe, *i*, which is of like materials to that at *h*, and is also supported above the water's surface by a buoy or other means. The pipe, *h*, is connected by a suitable passage with the air-vessel, as is shown in the drawing, and the pipe, *i*, is connected with the upper part of the helmet: *l*, is a stop-cock on the pipe, *i*, by which the diver can regulate the quantity of air which shall escape: *k*, is another flexible pipe, which is connected with the air-vessel by a suitable passage, as is clearly shown in the drawing, and to the diving-dress: *m*, is a stop-cock by which the air may be stopped off from, or permitted to flow to, the helmet through the pipes, *k*, *n*, there being a three-way cock, *o*, connecting the pipes, *k* and *n*, and also connecting the pipe, *m*[1], with the air-tight belt, *p*. Thus, when the handle of the cock, *o*, is upwards, the air is flowing, from *m*, to the helmet, but not into the belt, *p*; and when the handle of the cock is downwards, the air flows, from *m*, to the belt, *p*; the effect of which will be, that the belt will become inflated, and cause the diver to float to the surface of the water. And in order to supply the diver with air, *q* is a cock connected with belt *p*, and the diving-dress; on opening that cock the air will flow from the belt, *p*, to the dress, and if the handle of the cock, *o*, be raised upwards, the air in the belt, *p*, would quickly pass away, and the diver would again descend. By this means, the diver has great command of his rising and sinking in the water, and of supplying and regulating the supply of air: *q*, is an opening in the helmet of the diving-dress, which is closed by the cover, *h*, which screws on to the opening; within which is suspended a small compass, so as to retain its horizontal position.*

* Abridged from the Repertory of Patent Inventions, No. 42.

CONCRETE SEA-WALL—GROINS.

THE following is *a Description of the Concrete Sea-wall at Brighton, and the Groins which defend the Foot of it*, by Lieut.-Colonel Reid. This paper sets at rest the erroneous opinions formed by many builders, that mortar could not be made with sand from the sea-beach, or sea-water, as it would not set: it appears from the Report before us, that both were used, and with complete success. It is scarcely known to what extent concrete may be advantageously used; we feel convinced that it might be introduced for every variety of building, and with great economy, particularly near rivers, where clean ballast can be obtained, or near gravelly soils (the gravel should be washed, to clean it from alluvial impurities): in such situations concrete might be introduced at one-half the cost of Brick, and have the appearance of stone. Mr. Barry has very successfully introduced it in the new front of the College of Surgeons, Lincoln's-inn-fields, also the front of a house in Pall-mall. Mr. Ranger has built a small church with concrete, also several docks, wharfs, and numerous other works, and in the sea-wall at Brighton, with great success, as appears by the Report before us.

The portion of the concrete sea-wall now constructing at Brighton is 3,000 feet in length; and this portion, together with what is already finished, will make a length of about 2,000 yards of wall, the whole constructed of the sand and shingle from the beach alone, cemented by a water-lime from the neighbourhood, and mixed up with salt-water, the water having been taken from the sea itself, until it was found more convenient to sink wells immediately at the back of the wall, where some fresh water becomes mixed with the salt.

The section of the wall is two feet and a half thick at the top, upright at the back, without counterforts, and battering in the front with a slope equal to one-third of the height. The foundation goes down to the chalk, and from the bottom to the top it will, in one part, be seventy feet high, in many, forty feet.

The lime is not ground, but slaked at the work, as it is going to be used, and first mixed by hand with three parts of sand. It is next wheeled to a plug-mill, and then intimately mixed with three parts more of shingle, after which it is wheeled away and thrown upon the wall. In its semi-fluid state, it is retained by boards ledged together. The wall being backed up as it proceeds, the rear ledges are easily supported by struts. To retain the front ones in their places, ties are used, made of saw-plate iron, in strips passed through the boards, and keyed at the outer end. At the inner end, long iron needles pass through holes in the strips of saw-plate, and pin them to the ground. These needles and strips are easily drawn out, and used again as the work proceeds. The surface sets the second day, and in ten days the ledged boards may be removed.

The lime used in the concrete wall is taken from a pit near Bycombe, eight miles north of Brighton, and is a weak-water lime. The lime used for a row of houses now building of concrete, at Brighton, is from the pit of Southeram, near Lewes, and is also a water-lime. According to Mr. Mantell (who has so long studied the geology of the south-east of England), both these pits are in the strata of chalk-marl, lying under the

lower chalk formation; and it is to be found at the northern escarpments of the South Downs, and the southern of the North Downs. These two limes are similar to the Dorking and the Halling (near Rochester) limes; and it will be interesting to ascertain whether all the limes burnt from the same stratum have the same property.

It has been stated above, that the great sea-wall (at least in its new state) cannot resist the beating of the surge against it; and that its security depends upon the system of groins in its front. It is however deserving of remark, that some of the same concrete has been used near low-water mark, to fasten some piles at the lower extremity of one of the groins, which were loosely placed in large holes in the chalk bed of the sea, and which concrete was poured in, in its usual semi-fluid state. The place where it is, is almost always covered by the sea; yet it has become so hard that it resembles rock, and it was not found practicable, on examining it, to detach a single pebble from the mass without procuring iron tools.

Another trial of laying this concrete under sea-water has been successfully made at the outer end of the Brighton chain-pier. Some time back, large artificial stones of concrete made of the Bycombe lime were moulded, and after being allowed to harden on shore, they were placed at the feet of the outermost set of piles of the Brighton chain pier, to aid in securing them. These also have become very hard, and are now encrusted with shell-fish; whilst the chalk thrown in at the same place is soft and pulpy, and evidently wearing by the action of the sea.

These experiments led Mr. Wright, late surveyor to the Brighton Commissioners, and now employed upon the Dover Railway, to propose to construct a substantial groin of concrete, to be coped with stone, and having sides with gradual slopes. The Brighton Commissioners have not authorised this trial, however, to be made, which is to be regretted.

The contract price of the concrete in the great wall is fourteen shillings for each square reduced to fourteen inches thick, the Brighton mode of measuring, which is equal to three shillings and fourpence a cubic yard.

The following paper by Lieutenant Luxmore, giving *a Description of the Groins used on the Coast of Sussex for preventing Encroachments by Sea,* is instructive to the Engineer.

A short Description of the Use and Construction of Groins.

A groin is a frame of wood-work, constructed across a beach, between high and low water, perpendicular to the general line of it, either to retain the shingle already accumulated, to recover it when lost, or to accumulate more at any particular point.

The component parts of a groin are piles, planking, land-ties, land-tie bars, blocks, tail-piles and keys, and screw-bolts.

The length of a groin depends on the extent, and the requisite strength of its component parts on the nature of the beach on which it is to be constructed.

Those at Eastbourne, on the coast of Sussex, of which the following is more particularly a description, are from 150 to 250 feet in length; and the beach at that place being very rough, consisting of coarse heavy shingle and large boulders, they require to be composed of proportionably strong materials to resist its force.

The piles are from twelve to twenty-five feet long, and eight by six inches and a half scantling, shod with iron.

The planking is in lengths of eight, twelve, and sixteen feet, two inches and a half thick, and with parallel edges.

The land-ties are of rough timber, from twenty to twenty-five feet long, and large enough at the butt end to receive the bars.

The land-tie bars are thirteen feet six inches long, and twelve by five inches scantling.

The land-tie bar blocks are about two feet long, and of the same scantling as the piles.

The land-tie tail-keys are about two feet six inches long, and six by two inches and a half scantling.

The above materials are of oak or beech.

The screw-bolts are of inch round iron, two feet nine inches and a half, and two feet one inch and a half long, in equal proportions.

The relative proportions of the component parts are four piles, one land-tie with tail-piles and keys, one land-tie bar with two blocks, two long and two short bolts, about 180 square feet of planking, and about 140 six-inch spikes for every sixteen feet in length; and the expense of a groin, constructed with materials of the above dimensions, may be calculated at about 30*l* for the same length.

General Rules observed in the Construction.

When the object in constructing a groin, is to recover shingle, or accumulate more, the first pile is driven at the high water mark of neap tides, leaving its top level with that of spring tides. The next is driven at the point, on the sands beyond the bottom of the shingle, to which the groin is to extend, leaving about four feet of it out of the beach.

The tops of these two piles may be taken for the general slope of the groin, unless the beach should be very steep, and much curved, in which case it becomes necessary to follow its curvature in some degree.

From the high-water mark of neap tides, the piles are carried back nearly level to that of spring tides, and as much further as may be considered necessary

The piles are driven four feet asunder from centre to centre, and so as to admit the planking between them alternately, and they should be sunk about two-thirds of their length.

The longest piles are placed between the high-water mark of neap tides, and the bottom of the shingle, particularly from twenty to forty feet below the former point.

The planking is, if possible, carried down to about two-thirds from the tops of the piles, and kept parallel with them.

The land-ties are placed about one-third from the top of the planking, (supposing the latter to commence from the tops of the piles,) and their tails are sunk to the level of the bottom of the planking, or as nearly so as possible.

The method of uniting the component parts of a groin is shown by the accompanying plan, elevation, and section.

The land-ties have, in some cases, been placed on either side alternately, in which case one-fourth more land-ties, bars, &c. are required in the construction, because it then becomes necessary for the land-ties to overlap. The principal reason, however, for giving the preference to placing all the land-ties on the westernmost side is, that when placed alternately, those on the easternmost side are, from the general prevalence of westerly winds, liable to be left wholly exposed; and when in that state for any length of time, they are apt to free themselves from their tail-piles, and endanger the safety of the groin.

The planking should only be carried up to about one plank above the land-ties at first, and afterwards gradually completed, as the shingle accumulates, which should pass over it at about high-water, so as to form itself on the same level on both sides at the same time; for when the planking is carried up too high at first, the shingle is removed from the leeward side, by the general motion of its surface, in the direction in which the sea is running, before it has accumulated high enough on the windward side to pass over and supply the deficiency, so that when it does pass over, the reaction of the sea on the leeward side produced by the then difference of level, prevents it from settling there; and before this error was discovered, it frequently happened, when the wind continued in the same quarter for any length of time, that the planking became exposed to the very bottom on the leeward side, the shingle accumulated on the windward side, passed under it, and the groin becoming undermined, was soon destroyed.

When a set of groins are constructed, they are placed from fifty to one hundred feet or more apart, according to their length.*

COHESIVE STRENGTH OF BAR IRON.

The mean result of numerous experiments on wrought-iron, detailed in the *Journal of the Franklin Institute*, made by a Committee of the Institute at the request of the Treasury Department of the United States.

	Specific gravity.	No. of Experiments.	Strength† in lbs.
Missouri Bar Iron	7·7708	22	47909
Ditto Slit Rods	....	2	50000
Tennessee Bar	7·8046	21	52099
Salisbury, Connecticut	....	40	58009
Swedish Bar	7·4785	2	58184
Centre County, Pennsylvania	....	15	58400
Lancaster County, Do.	7·7400	2	58661
English 'E V best patent Cable bolt Iron'	7·6897	5	59105
Ditto Do. hammer hardened	7 6897(?)	8	71000
Russian Bar	7·8014	5	76069
Phillipsburgh Wire, diam. ·333	....	13	84186
Phillipsburgh Wire, diam. ·190	....	5	73888
Phillipsburgh Wire, diam. ·156	....	5	89162
Cast Steel	....	1	130681

The experiments were made at ordinary temperatures on bars of Iron, averaging ¾ inch by ¼ inch.

NEW HOUSES OF PARLIAMENT.

The first contract for the commencement of the works was entered into the beginning of September: the works are to be executed under the joint direction of Messrs. Walker and

* Transactions of the Corps of Royal Engineers; quoted in the Civil Engineer and Architect's Journal, No. 1.

† Breaking weight, deducting friction of a bar one inch square.

Burgess, civil engineers, and Charles Barry, Esq., architect. Messrs. Lee are the contractors; amount of tender reported at 73,335*l*. The works to be done under this contract are the most important in regard to construction; they comprehend the formation of an embankment 886 feet in length, projecting into the river 98 feet before the present embankment; the front will be in a line with the inner side of the third pier of Westminster Bridge, in four feet of water at low water; the whole to be surrounded by a river wall, 30 feet high from the base, and 1,141 feet in length, with a curvilinear batter, and faced with granite—a terrace 673 feet long next the river, and 35 feet wide, is to be formed in the front of the new Houses, with an esplanade at each end 100 feet square, and landing-stairs from the river 12 feet wide. The foundation wall of the front of the new building, the length of the terrace, and 30 feet high, is included in the contract; also the whole surface of the front building, which is to be excavated and filled in with concrete twelve feet thick, forming a permanent and solid foundation for the superstructure; a coffer-dam is to be made surrounding the works, 1,236 feet long and ten feet wide, before they can be commenced.

The following are the particulars of the construction:—The *coffer-dam* is to be first made by dredging a trench in the bed of the river, in the form of a segment of a circle, 27 feet wide, and 8 feet deep in the centre, which is done to allow the piles being driven the more easily; two parallel rows of guide or main piles of whole timbers will then be drove at five feet apart, leaving a width of nine feet between them transversely: to these piles will be fixed three tiers of walling of whole timbers, cut down and bolted together, one tier to be fixed at the top on a level with high-water mark, another level with the bed of the river, and the other midway; the piles and walling are then to be bolted across with iron-bolts twelve feet long, forming a carcass for the inner or sheet piling; the inner main piles are firmly braced to resist the thrust and pressure at high-water; the whole of the piles are 36 feet long, to be driven through the gravel and into the clay substratum two feet; the top of the clay is 28 feet below high water mark; within the walling will be two parallel rows of sheet piling, the outer or river side will be of whole timbers, and the inner or land side of half timbers. After all the piles are drove, the gravel forming the bed of the river between the piles will be excavated down to the clay, and the space between, 34 feet high and 5 feet wide, will be filled in with clay and puddled—there will be fender or guard piles at 10 feet distance from the coffer-dam, with floating booms to prevent craft running against the works. After the coffer-dam is complete, the bed of the river will be excavated the whole length of the river wall, 39 feet wide and 12 feet deep to form the terrace; the front and inner wall will be 24 ft. 9 in. high, standing on a course of concrete 1 foot thick, upon which will be bedded two courses

of 6 inch stone landings; the lower thickness of the wall will be 7 ft. 6 in., and the top 5 feet, with counterforts 16 feet apart, 3 ft. 9 in. wide by 3 ft. 4 deep; the back of the wall will be carried up perpendicular, and the front will be faced with granite, laid in horizontal courses 2 feet thick, with bond-stone 4 feet thick, and 6 ft. 6 in. apart; the face of the granite will form a curvilinear batter of 2 ft. 6 in. in 22 feet. At 30 feet distance from the inside of the river wall will be built the front wall of the new building, which is to stand on a foot of concrete, with two courses of 6 inch stone landing; the lower part of the wall is 6 ft. 4 in. wide, and the top 4 ft. 6, and 24 ft. 9 high. Between this wall and the river wall a space, 30 feet wide, 673 ft. 6 in. long, and 27 feet high, will be filled in solid with concrete to form the terrace; the foot of the river wall will be protected by sheet piling of whole timbers 8 feet long, with a walling along the top bolted with iron-bolts, 6 feet long and 4 feet apart, with screws and nuts let into the stone-landings of the footings; the river wall to the front and side of the esplanade will be 1 foot 2 inches, and 2 ft. 3 in. thicker than the terrace wall, and the whole surface of the esplanade will be excavated and filled in with a solid bed of concrete 20 feet thick.*

VAST STEAM-SHIPS.

We have inspected the new steam-ship fitting out for conveying passengers between London and Hull, named the *William Wilberforce*, lately launched from the building-yard of Messrs. Curling and Younge, at Limehouse. We do not remember having seen a finer or more perfectly formed steam ship afloat; her length over all, exceeds 200 feet, and her extreme breadth athwart the paddle-boxes 46 feet. When we inspected her the draught of water was only seven feet six inches, but without coals or water in the boilers.

We were much pleased with her engines, manufactured by Messrs. Hall of Dartford, and which are now being fixed on board in the East India Dock: we understand that they are the largest marine engines that have been put on board any vessel in the River Thames, and are only second in size to the engines which are now being manufactured for the new steam-ship building for the American trade, each of the engines of the *William Wilberforce* are of the computed power of 144 horses, having a stroke of six feet, and paddle-wheels 24 feet in diameter, and eight feet six inches wide. The two foundation plates upon which the machinery stands are each 26 feet long, and 5 feet 9 inches wide, with deep feathers or flanches and condensing chambers, all cast in one piece, and weighing between 11 and 12 tons. The forged work of the shafts and cranks is excellent, and from their magnitude such as could only have been accomplished by the powerful machinery as possessed by the house

* Civil Engineer and Architect's Journal, No. 1.

who supplied them, the Messrs. Acraman, of Bristol. The engines are provided with three cylindrical boilers, 25 feet in length, with interior cylindrical tubes or flues, the whole complete weighing between 50 and 60 tons. The chimney is of a novel construction, being inclosed in a jacket, forming an air-tight casing throughout its entire height, the space between the funnel and casing serving the twofold purpose of receiving the surplus steam from the safety valves, and thus dispensing with the ordinary waste steam pipe, and of keeping the interior of the chimney at a high temperature, and thereby increasing the draught through it, without that excessive and unsightly enlargement of its dimensions which would have been necessary on the ordinary construction. It also prevents the possibility of the sails or rigging of the vessel coming in contact with the chimney. The total weight of the boilers, engine, water, and complement of coals for the voyage, is estimated at 310 tons. We should have stated, that the engines, besides being provided with every precautionary contrivance against fire, bursting of boilers, and other casualties, are also fitted with Mr. Samuel Hall's, (of Basford,) patent condensers, which have been in successful operation in the *Hercules* and other steam-ships for nearly two years, and have fully answered the important purpose intended—that of supplying the boilers of marine engines with pure distilled water, instead of salt or muddy water, which on the ordinary plan is unavoidable, by which process the internal parts of the engines are not exposed to the corrosive effect of the salt injection water and salt vapour as with the common injection engine, and thus their durability as well as that of the boilers is greatly increased, while a more perfect performance of the engines is obtained with a diminished consumption of fuel.

We are indebted to Mr. Francis Humphreys for a view of the engines, under whose able directions they have been constructed. Mr. Humphreys also exhibited to us a model of an ingenious invention which he has lately made, for avoiding the possibility of marine boilers being deficient of water, or of their injurious expansion by the sudden shutting off the steam from the cylinders, so frequently occurring in navigating the river, or in going in and out of harbours, which causes serious injury to the boilers by straining the rivets, and opening the joints of the plates. The apparatus also renders explosion from under-pressure next to imposible: we shall at some other time give a description of this important appendage to steam boilers.

The *Great Western* steam-ship has just come into the East India Dock, to have her engines put on board; her build is of beautiful proportions, with a round stern. She was built at Bristol; her tonnage is calculated at 1,300 tons; she is to have two marine engines of 200 horse power each; the cylinders are 73½ inches diameter, and to have four boilers. She is intended to trade between London and New York.

The *Victoria* steam-ship, now building by Messrs. Curling and Younge, is the largest steam-vessel built in this country, and is intended for the same trade as the *Great Western;* her length on the water-line 230 feet: she draws when unloaded, 11 feet, when loaded, 13 feet; breadth of beam, 40 feet, depth of hold 28 feet; breadth, including paddle-boxes, 69 feet; her tonnage is estimated at 1,800 tons; she is to have two steam-engines of 230 horse power each; the cylinders are 78 inches diameter, paddle-wheels 30 feet diameter. Estimated to cost, including her engines, 100,000*l.**

ELECTRIC TELEGRAPH.

A MODEL to illustrate the nature and powers of this machine has lately been exhibited to the Edinburgh Society of Arts. The model consists of a wooden chest about five feet long, three feet wide, three feet deep at the one end, and one foot at the other. The width and depth in this model are those which would probably be found suitable in a working machine; but it will be understood that the length in the machine may be a hundred or a thousand miles, and is limited to five feet in the model merely for convenience. Thirty copper wires extend from end to end of the chest, and are kept apart from each other. At one end (which, for distinction's sake we shall call the south end) they are fastened to a horizontal line of wooden keys, precisely similar to those of a pianoforte; at the other, or north end, they terminate close to thirty small apertures equally distributed in six rows of five each, over a screen of three feet square, which forms the end of the chest. Under these apertures on the outside are painted in black paint upon a white ground the twenty-six letters of the alphabet, with the necessary points, the colon, semicolon, and full point, and an asterisk to denote the termination of a word. The letters occupy spaces about an inch square. The wooden keys at the other end have also the letters of the alphabet painted on them in the usual order. The wires serve merely for communication, and we shall now describe the apparatus by which they work.

This consists, at the south end, of a pair of plates, zink and copper, forming a galvanic trough, placed under the keys; and at the north end of thirty steel magnets, about four inches long, placed close behind the letters painted on the screen. The magnets move horizontally on axes, and are poised within a flat ring of copper wire, formed of the ends of communicating wires. On their north ends they carry small, square bits of black paper, which project in front of the screen, and serve as opercula or covers to conceal the letters. When any wire is put in communication with the trough at the south end, the galvanic influence is instantly transmitted to the north end; and in accordance with a well-known law discovered by Oersted, the magnet at the end

* Civil Engineer and Architect's Journal, No. 1. (October.)

of that wire instantly turns round to the right or left, bearing with it the operculum of black paper, and unveiling a letter. When the key A, for instance, is pressed down with the finger at the south end, the wire attached to it is immediately put in communication with the trough; and, at the same instant, the letter A at the north end is unveiled by the magnet turning to the right and withdrawing the operculum. When the finger is removed from the key it springs back to its place; the communication with the trough ceases; the magnet resumes its position, and the letter is again covered.

Thus, by pressing down with the finger in succession the keys corresponding to any word or name, we have the letters forming that word or name exhibited at the other end—the name Victoria, for instance, which was the maiden effort of the Telegraph. In the same way we may transmit a communication of any length, using an asterisk or cross to mark the division of one word from another, and the comma, semicolon, or full point, to mark breaks in a sentence, or its close. No proper experiment was made, while we were present, to determine the time necessary for this species of communication; but we have reason to believe that the letters might be exhibited almost as rapidly as a compositor could set them up in types. Even one-half or one-third of this speed, however, would answer perfectly well.

Galvanism, it is well known, requires a complete circuit for its operation. You must not only carry a wire to the place you mean to communicate with, but you must bring it back again to the trough. Aware of this, our first impression was, that each letter and mark would require two wires, and the machine, in these circumstances, having sixty wires instead of thirty, its bulk, and the complication of its parts, would have been much increased. This difficulty has been obviated, however, by a simple and happy contrivance. Instead of the return wires extending from the magnet back to the keys, they are cut short at the distance of three inches from the magnet, and all join a transverse copper rod, from which a single wire passes back to the trough, and serves for the whole letters. The telegraph, in this way, requires only thirty-one wires. We may also mention, that the communication between the keys and the trough is made by a long, narrow basin, filled with mercury, into which the end of the wire is plunged when the key is pressed down with the finger.

The telegraph, thus constructed, operates with ease and accuracy, as many gentlemen can witness. The term model, which we have employed, is in some respects a misnomer. It is the actual machine, with all its essential parts, and merely circumscribed as to length by the necessity of keeping it in a room of limited dimensions. About twenty gentlemen, including some of the most eminent men of science in Edinburgh, have subscribed a memorial, stating their high opinion of the merits of

the invention, and expressing their readiness to act as a committee for conducting experiments upon a greater scale, in order fully to test its practicability. This ought to be a public concern. A machine which would repeat in Edinburgh words spoken in London, three or four minutes after they were uttered, and continue the communication for any length of time, by night or by day, and with the rapidity which has been described—such a machine reveals a new power, whose stupendous effects upon society no effort of the most vigorous imagination can anticipate.*

HYDRAULIC TELEGRAPH.

A NOVEL and ingenious method of conveying intelligence from one place to another has been lately invented by Mr. Francis Whishaw, of South Square, Grays-inn, in which place there is now a model of the contrivance. The principle on which the process is carried on depends on the well-known fact of water always finding its own level, (unless some circumstances where operated upon by suction, &c.,) or, in other words, of every part of a stream of water, when left to its natural tendency, continuing to be equidistant from the centre of gravity. The invention is worked by the rising or depression of water, and is therefore appropriately called the "Hydraulic Telegraph."

The detail of it is as follows:—It is proposed to place station-houses at various distances, from 20 to 30, 40, or 50 miles apart, the distances to depend upon the nature of the ground to be traversed, as to its being a level or an unequal surface. From the *termini* of the line, to which the communications are to be made, and of course through the station houses, leaden pipes are to be laid down at a distance of about five feet from the surface of the earth. In these pipes there is always to be a sufficient supply of water. At the *termini*, say London and Liverpool, and at each station, pipes are to extend from the main pipes into a proper apartment, and an apparatus of glass pipes to be placed at the extremities of them. These glass pipes will be perpendicular, and placed upon a table of figures, which figures by means of a vocabulary or dictionary, are known to represent certain words, and are interpreted by reference to the dictionary, or to the knowledge of their signification, which will arise from memory or practice. By cocks fixed to the pipes at each station and at the *termini*, the water in the pipes can be heightened or lowered in such a manner as may be required to enable the water in the glass pipes to rise or fall, so as to bring the upper surface immediately opposite any figure on the table that may be necessary to represent the correspondent word or syllable or sentence in the dictionary. The water rising or falling in the glass pipe instantaneously, and by the principle of always finding its level, rising

* Scotsman; quoted in the Mirror, No. 866.

or falling at the pipes at the corresponding stations in a space of time incredibly rapid. By this means the communication is made from one station to another with the greatest accuracy and velocity, and with little danger of disarrangement.

Another detail of the same principle, which is appended to the model of this contrivance now exhibited at the office of Mr. Whishaw, is the use of cylinders at the extremity of the pipes at the stations, in which cylinders are floats, to one of which floats, in one contrivance, an upright piece of wood is fixed, which operates upon a transverse horizontal index traversing a sextant table, on which the figures representing the words are marked; and on a float in another cylinder an upright index is placed, having a small, horizontal piece of wire pointing to figures on an upright oblong table.

These last two methods are elegant and ingenious, but do not perhaps, at least as far as can be discerned at a first and cursory inspection, materially improve the machine. The pipe of the model now in operation, extends from a back room in the office of the inventor through a larger room, and into a third apartment. The pipe is about half an inch in diameter, a dimension said to be large enough for the actual plan, convoluted and twisted in many folds, in order to render the distance through the pipe as long as possible. At each end of it cocks to regulate the water, and upright glass pipes, such as have been described, with tables of figures, are affixed, in which the water mounts and falls by the regulation of the cocks, the surface pointing to the figures on the tables, as mercury or spirits of wine in a thermometer points to the scale of heat and cold. In the experiments which have been made, sentences of several words have been communicated with the greatest rapidity from one room to the other, and the interpretation, although the vocabulary of Mr. Whishaw at present has not above twelve thousand words, has been perfect.

The rough estimate of the expense of a telegraph of this sort, including stations and contingent expenses, is 200*l*. a mile. The invention is exceedingly curious, though dependent on a well-known and simple principle. It is well worthy a visit from all scientific persons, and from all who are interested in the rapid transmission of intelligence from places at great distances apart.*

A NEW REFLECTING MICROSCOPE.

By Mr. Guthrie.

Mr. Guthrie modifies Amici's microscope, by removing altogether the plane speculum, and placing the object to be viewed in the axis of the tube. This arrangement is to the microscope what Sir W. Herschel's is to the reflecting telescope. In order

* Times; quoted in the Mirror, No. 870.

that the object may be properly illuminated, the part of the tube next the mirror is wholly removed, and three pillars substituted for it, to one of which the stage for the object is attached, and regulated by an adjusting screw.*

IMPROVEMENT IN THE CONSTRUCTION OF WOLLASTON'S GONIOMETER.

By Edward Sang, Esq., F. R. S. E., Vice-Pres. Soc. Arts, Teacher of Mathematics, &c. Edinburgh.†

THE science of crystallography has now become, on account of its connexion with the new subject of polarized light, a most

† Read before the Society of Arts for Scotland, 13th April, 1836,—the Society's Honorary Silver Medal awarded 7th December, 1836.

Report on Mr. Sang's Improved form of Wollaston's Goniometer.

Your commitee have examined carefully Mr. Sang's addition to the goniometer, which consists of a plane mirror capable of being adjusted, so that the plane of reflection shall be perpendicular to the axis of the instrument.

Instead of bringing the image of an object (such as the bar of a window) reflected from the surface of the crystal whose angle is to be measured, to coincide in direction with a second object (such as a window bar parallel to the first,) Mr. Sang proposes to employ the reflection of a single object from a plane mirror attached to the instrument.

This modification, though very simple, affords great facility of practical application. In using the instrument in its usual form, the image of the first object (A), reflected from the crystal, can only be brought to coincide in direction with the second object (B), seen by direct vision, whilst the instrument remains perfectly at rest: and this however distant either object. Alter the position of the goniometer, and the crystal attached to it by the smallest quantity, and the reflected image of A will be displaced from its apparent coincidence in direction with B, by twice the angle through which the reflecting surface of the crystal has been shifted. The result is, that the slightest unsteadiness of the hand or the instrument produces some uncertainty in making the coincidence. By using a *permanent* reflecting surface attached to the instrument itself, to afford a second image of A to answer the end of the object B, any displacement or tremor of the instrument affecting both surfaces equally, does not impair the accuracy of the adjustment, so that the instrument in its improved form may be as accurately used in the hand (like the reflecting circle or sextant) as when clamped to the firmest table. If the distance of the object A be considerable, the adjustment amounts simply to making the reflecting plane of the crystal parallel to the permanent reflecting plane secured to the instrument.

Your committee are persuaded, from actual experiment, that this addition to the reflecting goniometer, although so simple, is one of great practical consequence; and the reporter desires to add, from his personal knowledge, that, although only now presented to the Society, Mr. Sang has employed this principle in practice for several years past.

JAMES D. FORBES (*Reporter*).

25th May, 1836.

* Jameson's Journal, No. 44.

important branch of stereometry. Almost the only instrument employed in crystollographic researches, is the reflecting goniometer contrived by Wollaston; but that instrument, in its ordinary form, is of troublesome and uncertain application. It is, in fact, an incomplete instrument, inasmuch as it does not contain, in its own construction, all the elements from which the determinations are to be made. Before it can be applied to the measurement of the inclination of two faces of a crystal, a pair of parallel lines must be traced at a considerable distance from the table or stand on which the instrument is placed, and exactly at equal distances from the axis of its motion. The axis has also to be rendered parallel to these lines; and all this is preparatory to the adjustment of the crystal. The goniometer in this form is much inferior to the spindle of the turning lathe. It is for accurate purposes as completely a fixture as the lathe, and at the same time wants its steadiness and dimensions. I long employed the head of my lathe as a goniometer, and, having obtained a graduation to single minutes from Mr. Adie, I continue to employ it whenever the objects are of considerable dimensions. By measuring the height of the reflecting surface above the centre, as given by the tool of the slide-rest, the argument of the parallax is readily obtained, and thus nothing more is left to be desired than portability. By a very simple contrivance, even the repetition of the angle can be obtained, and any error in dividing or centering the graduated limb corrected; this addition, however, I have not found it necessary to adopt.

As it may be useful to those members who have turning-lathes, to know how these may be converted into accurate angular instruments, I shall detail the necessary modifications.

The first requisite is a *slow motion* or *tangent screw* for the spindle. That usually adopted in the theodolite answers very well; still better would be that employed by Robinson in his small astronomical circles. No turner of any standing can feel the least difficulty in constructing this for himself. The next thing is to obtain an accurately graduated circle. For this a circle of brass should be accurately fitted to some part of the spindle or pulley, and made so carefully that it may be removed and replaced with certainty. This must be sent to the dividing engine to receive the graduations. The limb on my lathe is 6·9 inches in diameter, and is graduated in thirds of degrees; the subdivision into single minutes being effected by means of a vernier. As soon however as possible, I mean to construct a micrometer for the same purpose, because by its help the position of the eye in reading off may be rendered more convenient; and also because the edge to which the vernier applies has become considerably rounded.

From this addition, the lathe receives a great augmentation of power. It can be employed as a graduating instrument, par-

ticularly in cases where the graduations are to be unequal, as in logarithmic circles, &c.; or it is competent to the construction of orrery wheels, when the deviation from the mean motions are to be shown; it is also useful, in conjunction with the graduations of the slide rest, for placing a series of points on a piece of work by means of their polar co-ordinates. I find no difficulty in guiding my tool by such means, within the thousandth part of an inch of the required place.

To use the turning lathe thus fitted up as a reflecting goniometer, we have only to provide an adjusting chuck which may enable us to adjust the position of the crystal attached to it. The plan I adopted is this:—Being already in possession of a cylindric chuck, with eight adjusting screws, which I used for turning pivots accurately, I took a square bar of iron and placing it in the chuck, well centred, turned a portion of the end conical: to this cone I fitted a small piece of brass with a flat face, on which to cement the crystal or prism whose inclination is wanted.—By means of the adjusting screws, four of which work on one end, and four on the other end of the square bar—the faces of the crystal can be rendered parallel to the axis of the lathe. The first approximation can be readily obtained by causing the reflected image of one side of the shear to agree with the direct image of the other. To obtain the final and accurate adjustment, the following process is adopted:—On the opposite wall of the room is fastened a paper scale, with divisions marked so strongly as to be perceived readily from the lathe; and near the floor on the same wall is placed a small black circular mark. The image of the scale is then brought to coincide with the circular spot, and the division which culminates it is noted. Turning the lathe head half round, the reflection of the spot is brought in contact with the scale, and if the same division be again read off no further adjustment of that face of the crystal is needed; if any difference exist, one half of it is to be corrected by means of the screws in the chuck. To save time in after adjustments, there is then placed a distinguishing mark at the mean of the two readings, and this mark is ever afterwards compared with that at the bottom of the wall; at least if the position of the lathe be not changed. If the two marks be placed at the same distance from the axis of the lathe, the two readings on the graduated limb will not differ from each other exactly by 180°; but by that + or — twice the parallax arising from the face of the crystal not passing actually along the axis of the spindle. Half the sum of the two readings then will be freed from the influence of parallax. The analogous half sum obtained from the other face of the crystal will also be freed from parallax, and thus the difference between the two half sums will give exactly the inclination wanted.

To repeat the measurements on another part of the limb, we have only to turn the piece of brass round on the cone to which

it is fitted: but as the axis of the cone is not coincident with that of the spindle, unless by chance, a new adjustment of the crystal is then needed The repetition is, however, scarcely called for, as the readings have always been taken on opposites of the limb, so as to eliminate the error in centering, while no errors need now a days be feared in a gradnation to minutes.

This apparatus is, as many trials have convinced me, quite sufficient to give the inclination of two reflecting surfaces to the nearest minute; nor does it seem to me that, in order to render it still more precise, anything else is required than the addition of the telescope, and the use of more delicate graduations. Although a very convenient appendage to the workroom, it is by no means adapted for the general purposes of the crystallographer, who requires a portable and manageable tool.

The manipulation of the common reflecting goniometer resembles that above described in every thing but the steadiness and certainty of the operations; one source of inaccuracy so exceeds all the rest, that it may serve at once to characterize the instrument; I mean the instability of the frame which carries the reader: this results from the goniometer being detached from the two parallel lines or objects of comparison, and from its extreme lightness. Any change in position which occurs during the observations induces an error in the results; and unless particular precautions, such as fastening the instrument to the table, be taken, the measurements can never be entirely depended on.

It is by no means difficult to obviate this inconvenience, and to give at the same time a compact and completely portable form to the common goniometer.

For this purpose, I fix upon the sole of the instrument a small plate of brass, by means of two screws, one of them working in a round, and the other in an elongated opening; so that the brass may have a limited motion round the first, and may be clamped in any required position by the second screw. To this I attach a small stage with its upper face inclined about 45°, the particular inclination being of no moment, and on that face I lay a piece of good thin plate glass.

Instead of bringing the reflected light of an object to coincide with the direct light of some other object, I cause it to coincide with that reflected from the plate glass. When this coincidence is obtained, the one reflecting surface is parallel to the other, at least if we neglect the parallax. The next coincidence will place the second plane in the same situation, and thus the inclination will be at once obtained, provided the parallaxes in the two cases are alike.

By means of the permanent reflector, we can make all our observations on images of one object, which we can take as distant as convenient; the coincidences will thus be more easily observed than those of one object with another. The parallax

can always be rendered so small as not to influence the results; indeed, by using an object at the distance of half a mile, it will be entirely avoided. But, even although circumstances should compel us to use a proximate object, the parallax can be readily and advantageously eliminated from the observations; before, however, any observations are made, the permanent reflector must have its plane rendered parallel to the axis of the instrument. The limited motion of the brass arm enables us to make this adjustment. A substance with a pretty extensive and well-polished face is cemented to the goniometer, and the image of a distant object in it is made to coincide with that seen in the permanent reflector. The limb of the goniometer is then turned half round, when, unless the adjustment happen to have been hit at first, the instrument, *when used as a sextant*, by receiving the direct light from the object, and the twice-reflected light from it at the same time, will not exhibit again that coincidence. The two images will appear in a plane passing along the axis of the motion, and, by the motion of the permanent reflector, one-half of the distance must be corrected; the other half by the motion of the adjusting apparatus on the goniometer. After this, the operation is to be repeated until no error appear; the permanent reflector is then placed parallel to the axis.

The possibility of obtaining a coincidence will now be sufficient to show that the face of a crystal is placed properly on the goniometer. During all these operations the instrument may be held in the hand like a reflecting circle, the coincidence being entirely independent of the absolute, and depending only on the relative positions of the parts. Indeed, if the observer were provided with a silvered mirror attachable to the axis, the instrument would become an efficient reflecting circle.

If all the observations be made on one object, that part of the parallax which depends on the distance of the axis from the point at which the reflection takes place on the permanent reflector will be constant, and will influence all the readings in the same way, it may therefore be entirely neglected; only that, when the object is very near, care must be taken to use the same part of the surface, or to direct the eye in a fixed way in regard to the parts of the goniometer: this, however, only when the distance is a few feet. The parallax, depending on the distance from the axis of the instrument to the face of the crystal, must, however, be attended to. In the direct observation this parallax will affect the reading in one way; in the back observation the same parallax has the opposite effect, so the amount of the two readings is freed from its influence; and thus half the difference between the sum of the readings in the one face and the sum of the readings in the other face of the crystal will be their inclination. By using this process, the error of centering is entirely corrected; it is, however, troublesome when the crystal is minute, and the repetition of the measurement by the direct me-

thod is preferable, the object being taken at some considerable distance.

The surface of the permanent reflector must not be too bright, otherwise the light from it will be too strong, and prevent the distinct vision of the other image. By moving the eye a little backwards and forwards a position can be found which will give to both images the like brightness, and thus facilitate the estimation of the coincidences.

In conclusion, I remark, that the stops affixed to the instrument, as ordinarily made, impede very much the work; on which account I would recommend their removal from it even in its usual state.*

BLAST-FURNACES AND FORGES.

Mr. John Isaac Hawkins, of Pancras Vale, Hampstead, has patented a certain improvement in the blowing-pipe of blast furnaces and forges, which he describes as follows:—

The improvement consists in so forming the mouth or mouths of the blowing-pipe as to deliver the usual supply of air into the furnace or forge in a thin sheet or in thin sheets, possessing great surface in proportion to the bulk or volume of the stream of air, in order that the air may impunge upon and impart its oxygen immediately into a large quantity of ignited fuel, the more advantageously to promote combustion, and also to avoid the comparatively chilling effect which is produced by the pouring in of cold air in a body of considerable thickness, as is the case in the ordinary mode of delivering it through a circular orifice or through two, three, or even four circular orifices.

In carrying this improvement into effect, I sometimes enlarge the common circular orifice of the mouth-piece or extremity of the blowing-pipe next to the fire to three or more times the usual diameter, and place a conical plug concentrically within the same, with the apex of the cone pointing towards the bellows or blowing-machine, and the base of the cone lying even with the end of the mouth-piece towards the fire, or lying a little within or a little without the end of the mouth-piece, the dimensions of the base of the cone being such as shall leave an annular aperture or air passage between the cone and the pipe equal in area to the area of the ordinary mouth-piece or to the conjoint areas of both, or of all the mouth-pieces, when two or more are used. By this arrangement the air is delivered in such a thin cylindrical sheet, that its contained oxygen will find immediate access to the ignited fuel, and augment the intensity of the heat more advantageously than can be effected by a thick stream of cold air, or by two, three, or four such streams; and I support and retain the cone in its place within the pipe or mouth-piece by means of two pins or bars passed horizontally through the sides of the pipe and through the sides of the cone, the pins or bars crossing at right angles the common axis of the cone and of the pipe; and I also place lateral guides to assist in keeping the cone concentric with the pipe, and I sometimes elongate the two holes in the cone, so that the cone may slide a short distance across the pins in the line of the common axis of the cone and of the pipe, upon being moved by a lever having its fulcrum in or near the side of the

* Jameson's Journal, No. 44.

pipe, one arm of the lever projecting outwards from the pipe, to which arm the power may be applied, and the other arm within the pipe reaching to the apex of the cone where it takes hold of a link affixed in any common manner to the apex of the cone. The lever, on being moved on its fulcrum by its outer arm lengthwise of the pipe, will cause the inner arm to move the cone in the line of the common axis of the cone and of the pipe. And I sometimes make the extremity of the mouth-piece surrounding the base of the cone a little conical, enlarging outwards towards the fire, whereby the sliding of the cone in the common axis will enlarge or diminish the area of the annular aperture, according as the sliding cone is carried towards or from the fire. And I sometimes carry the invention into effect by making the blowing pipe with two or more branches, each branch terminating in a mouth-piece having a long narrow orifice delivering the air into the furnace or forge, in a thin broad sheet, the conjoint areas of all the oblong orifices being equal to the area of the single circular orifice as commonly used. And in the case of a blast-furnace, whether of the large kind for smelting of iron, or of the smaller kind called a cupola in which cast-iron is melted; I distribute the mouth-pieces around the furnace, so as to deliver the thin broad sheets of air into the fire at nearly equal distances. And in the case of a forge I distribute the mouth-pieces at equal distances along the fire according to the length required to be heated, and I place the greatest dimensions of the orifices vertically, and make them of such a height as shall the most effectually blow up a fire of the altitude required. And I sometimes make use of five or more mouth-pieces with circular orifices, but although they are much superior to a less number, I do not deem them so advantageous as the oblong form hereinbefore described. And I declare that I lay no claim to the mode hereinbefore described of sliding the cone within the mouth-piece, nor to the application of two, three, or four mouth-pieces with circular orifices. But I do claim as the invention, the enlarged mouth-piece, within which is placed concentrically a conical plug, of such dimensions at the base as shall leave an annular aperture for delivering the air into the fire in a thin cylindrical or conical sheet, as hereinbefore particularly described; and I also claim the application of two or more mouth-pieces with oblong orifices for delivering the air into the furnace or forge in thin and broad sheets. And finally, I claim the application of five or more mouth-pieces with circular orifices for the purpose of greatly increasing the surface of the stream of air in comparison with its volume.*

MANUFACTURE OF CAOUTCHOUC FABRICS.

Mr. C. Nichols, of Lambeth, has patented certain improvements in preparing and manufacturing caoutchouc, the outline of which he thus describes :—

The invention relates,

"First, to making caoutchouc thread from caoutchouc, ground and pressed.

Secondly, to improvements in machinery, whereby I am enabled to cut tapes or sheets of caoutchouc into a number of threads at one time, whether such tapes or sheets be obtained from ground caoutchouc, or from bottle or other caoutchouc.

* Repertory of Patent Inventions, No. 44.

Thirdly, the invention relates to the cutting of thread from the external edges of a series of discs of caoutchouc, each of them being of the intended thickness of the thread.

Fourthly, the invention relates to spirally twisting caoutchouc threads, with threads of cotton, silk, and other fibrous materials, in such manner as to give a protection or guard, to the caoutchouc thread in the process of weaving.

Fifthly, the invention relates to a mode of making fabrics water and air proof, by the aid of caoutchouc, without the necessity of first bringing such substance into a state of liquid solution.

Sixthly, the invention relates to a mode of weaving ornamental elastic webs or fabrics.

Seventhly, in the application of caoutchouc to book-binding, for combining the leaves thereof in place of sewing, and also for covering the backs and covers thereof, as hereafter described.

According to the ordinary practice of manufacturing caoutchouc into thread, that description of caoutchouc is employed which comes over to this country in the form of bottles; and in order to cut and form the same into thread for weaving purposes for making elastic fabrics therefrom, the workman takes a bottle of caoutchouc, and cuts off the two ends, then draws the bottle on to a roller of wood, and the cylinder of caoutchouc is cut from end to end, in a spiral direction, producing a narrow thin tape or sheet of caoutchouc, which is cut into threads by a succession of longitudinal cuts, by means of a circular revolving cutter, or knife; these threads are then what is called "spun," that is, they are considerably drawn out, and wound on to a reel, where they remain for some length of time, and become set, and have little, if any elasticity. And there has been thread produced from that description of caoutchouc, which comes to this country in the form of blocks, for which purpose it is necessary to obtain the best qualities of block caoutchouc, such as are of close texture, and having but few or no pores or cells, both which descriptions (the bottle and the best block caoutchouc) are of the most expensive kind; and in cutting the same into thread, there is considerable waste, which has heretofore been only useful for the purposes of being dissolved by coal oil, or other suitable solvents, as is well known and understood.

Now, by the first part of the invention, such cuttings (produced in the former modes of making thread from the better classes of caoutchouc, which have heretofore been those used for making thread,) or any cuttings or small pieces of caoutchouc, may be so treated and manufactured as to become suitable for making thread; such is the case with the cuttings of caoutchouc, which are at present considered inferior in consequence of their porous condition, or want of equality or closeness.

The further details of this useful invention, illustrated with many diagrams will be found in No. 46 of the *Repertory of Patent Inventions.*

RAILWAY TUNNELS.

MR. HENRY BOOTH, of Liverpool, has patented certain improvements in the construction and arrangement of railway tunnels, to be worked by locomotive engines, which he describes as follows:—

My improvement in the construction and arrangement of railway tunnels to be worked by locomotive engines, I declare to consist in the formation of duplicate tunnels near and parallel to each other, but with different and opposite gradiants, there being in each tunnel one line of railway, instead of forming, as is usually done, one large tunnel with two lines of railway, both lines having the same inclinations or gradiants, and the difference of gradiants which I recommend for a general practice, is, after the rate of twelve to fourteen feet per mile, (that is to say), supposing the tunnelling to be effected be one mile in length, and which, on the ordinary construction hitherto adopted, would consist of one tunnel with two lines of way through it, and that on the ordinary plan the same would be formed on the level, I recommend the construction of two tunnels having each one link of railway, describing twelve or fourteen feet in the direction of the moving traffic, which arrangement may be accomplished by raising one out of each duplicate tunnel, and depressing the other six or seven feet from the level line, each tunnel inclining twelve to fourteen feet in the direction of the moving traffic through the said tunnel. Or supposing the tunnelling to be effected be one mile in length, and that on the ordinary construction hitherto adopted, it would consist of one tunnel with two lines of way, having each an inclination in the same direction, of twenty-four to twenty-eight feet per mile, I recommend the construction of two tunnels; one of them (the descending line in the way of the traffic), having the aforesaid proposed inclination downwards of twenty-four to twenty-eight feet per mile, and the other (the ascending line in the way of the traffic) having an inclination upwards of only twelve to fourteen feet per mile, instead of twenty-four to twenty-eight feet, as it must have if the two lines of way are in the same tunnel; and the advantage of this arrangement and construction is that the passage through the tunnel, when on the ordinary construction, it would either be on the level or on the ascent, is eased and facilitated to the extent of twelve to fourteen feet comparative declination per mile, that is to say, to the extent of about one half of the whole force of traction required to overcome friction on a railway. The object to be attained is an easy and quick passage through the tunnels, and as from the moist state of the rails in most tunnels, the adhesion (and consequently the efficiency of the engine will be very much diminished), it becomes desirable so to arrange the gradiants of the line in the tunnels, by raising or depressing the contiguous portions of the railway, that the passage through the tunnels in each direction may be effected more easily than on the contiguous parts of the road.

By this arrangement it is not proposed to gain any ultimate mechanical advantage, because as many feet as the engine moves downwards (by altering the uniform line of gradiants in the tunnel), it must either previous or subsequently move upwards on the open railway, but the advantage is that you choose your ground, and it being doubly important that no delay should take place in the tunnel, and from the state of the rails, &c, the greatest difficulties presenting themselves at that spot, I so arrange the gradiants of the tunnels and of the contiguous parts of the

roads, that whether on a level or on an ascending line of country, only about one half the resistance in traction shall be met with in the tunnel as on the open railway, the chances, therefore, are that if a locomotive engine, (which is subject to so many casualties,) fail in the journey, it will not fail in the tunnel.

Now though I have named a difference in the gradiants or inclinations in the duplicate tunnels of twelve to fourteen feet per mile, I do not confine myself to those exact proportions, one half this difference would be preferable to no difference; the object to be attained by the adoption of my plan being so to raise or sink the contiguous portions of the railway forming the approaching lines to the tunnels, and the departing lines from the tunnels in each direction, and so to arrange the gradiants in the duplicate tunnels, that the passage through the tunnels in each direction by locomotive-engines may be effected as far as depends on the levels or inclinations more easily than on the contiguous portions of the open railway.*

STEAM-ENGINE CYLINDERS.

Mr. William Mason, of Camden Town, has patented certain improvements in the manufacture of Steam-engine Cylinders, Pistons, Bearings, Pumps, and Cocks, of which the following is the specification:—

My invention of improvements in the manufacture of steam-engine cylinders, pistons, bearings, pumps, and cocks, consists in carbonating and hardening the working surfaces of such parts of steam-engines when made of iron, whereby steam-engines, when so improved, will become capable of wearing longer, with less liability to derangement, than when steam-engines are manufactured with working surfaces made according to the methods now pursued. In order that my invention may be most fully understood and carried into effect, I will proceed to explain the best means with which I am acquainted for performing my improvements; in doing so, I will first describe the processes, as applicable to the carbonating and hardening of the internal or working surface of the steam-cylinder, or of the air-pump cylinder of a steam-engine, I will afterwards explain the improvements as applied to the other parts of steam-engines herein mentioned.

I will suppose that I am about to operate on the steam-cylinder or air-pump cylinder of a steam engine, which is only in the state of a rough casting of iron in the form of a steam-cylinder or air-pump cylinder of a steam-engine. Before I proceed to bore out the inner or working surface, I prefer to submit the casting to the process of annealing, by placing it in a suitable reverberatory or other furnace capable of raising the heat of the cylinder to a red heat, the fire is then to be put out, and the cylinder is to be permitted to cool down, and, when cold, to be removed from the furnace. The inner or working surface of the cylinder is to be truly and accurately bored, its working or inner surface will then be ready to undergo the process of carbonating and hardening. It should be remarked, that it is not essentially necessary that the cylinder or other parts of the steam-engine should be subjected to the process of annealing, though it is preferable, for the future process having to be carried on by means of a red heat, it is desirable first to submit the parts of the engine to a like extent of heat, and gradually to cool them in order that any

* Repertory of Patent Inventions, No. 46.

warping, winding, or distortion of shape or figure, consequent on such heat, (if the metal should prove to be unequal), may take place before the boring of the inner surface, that such irregularities may be removed by that operation of boring, otherwise great difficulty may arise should any inequality or irregularity of surface be found after the carbonating and hardening processes have been performed on the cylinder which will sometimes be found to be the case, if the cylinder be at once bored and submitted to the carbonating and hardening processes without being annealed, but having been annealed the cylinder will not be liable to be materially altered in the correctness of its surface by the future processes to which it must be submitted in order to apply my improvements thereto.

The cylinder thus prepared is to have placed within it a cylindrical core of cast iron, three or four inches less diameter than itself, by which means there will be an open space all round between the two cylinders, which is to be filled with ground bones or other animal matter capable of forming animal charcoal, or animal carbon, or the space may be filled with animal charcoal at once. The two ends of the cylinders are then to be securely closed by rings of iron, and luted with clay or other suitable material, in order to prevent the admission of atmospheric air to, or the emission of the vapours or gasses from, the animal carbon. In this condition the cylinder is to be placed in a reverberatory or other suitable furnace capable of raising the heat of the cylinder to, and retaining it at, a red head (cherry-red). The workman will observe, that when the cylinder becomes throughout of a cherry-red heat, he will continue that heat for about four or five hours, by which time the carbonating process will be sufficiently performed. The cylinder with its contents is then to be removed from the furnace, and carefully, though quickly, to be lowered into a pit or well containing water (which should by preference contain a small quantity of salt), sufficient to cover it completely, where it is to remain till cold, by this means the inner or working and now carbonated surface will become exceedingly hard. Having applied the processes of carbonating and hardening to the inner or working surface of the cylinder, the core and animal charcoal is to be removed from the cylinder, and it is next to be ground by means of emery and water on lead, in order to remove any slight irregularity of surface which may be found to exist. Steam-cylinders or air-pump cylinders manufactured with my improvements thereto, will be found less liable to wear away by the working of the pistons within them, and will consequently last much longer, and will offer less friction in the working of the pistons than when the cylinders are manufactured in the ordinary manner now in use. It should be stated that the animal charcoal or carbon produced in the first instance as above described, may be used over and over again, consequently the cost of the improvements will not be considerable, the labour and fuel being the chief expense.

Having thus described the improvements as applicable to the steam cylinders and air-pump cylinders of steam-engines, I will proceed to describe their application to the pistons of steam-engines. In case such pistons are not of a greater diameter than six inches, then they may be made solid of cast or wrought iron, and are to be accurately turned so as nearly to fit the intended cylinder, being left a little too large to allow of grinding; I place them within cast iron rings or cylinders of a larger diameter, leaving room all round for the animal carbon or charcoal, and cover the two ends as above described, and then pursue precisely the same course as that before explained with reference to the steam cylin-

ders and air-pump cylinders. In case the pistons are of a larger diameter, and are made of several segments and wedges, such for instance as those known as Barton's patent pistons, in such case when the parts or segments and wedges of cast or wrought iron have been accurately formed and fit their intended cylinders, they are to be placed in suitable frames or boxes, and submitted to the processes of carbonating and hardening hereinbefore described. The surfaces are afterwards to be ground with emery; they will then be complete, and will, in like manner with the cylinders, be found to work much more easy, and wear longer, and be less liable to get out of order than when manufactured as heretofore.

I will now describe my improvements as applicable to steam-engine bearings. In this case the bearings are to be accurately bored or formed, (by preference), of cast iron, (or they may be of wrought iron); they are to be placed in suitable boxes, and submitted to the processes of carbonating and hardening in like manner to the cylinders above described; the working surfaces are to be afterwards ground with emery, and are then ready for use.

I will now describe my improvements as applied to steam-engine pumps for pumping hot or cold water. The cast or wrought iron barrels thereof are to be accurately bored, and are to be submitted to the processes of carbonating and hardening as applied to the cylinders, and as fully explained above; but in case the barrels of the pumps are small, it will not be necessary to have any interval, core or cylinder, but the same may be wholly filled with animal carbon or charcoal, and the plungers or pistons are to be of iron, and submitted to the same processes.

The inner or working surface of the barrels or cylinders are afterwards to be ground with emery as before described; they will then be completed: and such also is to be the case with the pistons or plungers.

I will now describe the application of my improvements to turning and sliding cocks for steam-engines.—Having accurately formed the barrels and plugs of turning cocks of cast iron, (they should by preference be cylindrical), and by boreing and turning made their working surfaces correct to each other, or as nearly so as possible, and formed the sliders as flat and true as may be, their working surfaces are to be submitted to the processes of carbonating and hardening in like manner to the other parts of steam-engines hereinbefore explained; and afterwards the parts are to be ground together by emery.

Having thus described the nature of my invention, and the manner of carrying the same into effect, I would observe that I have not thought it necessary to describe more fully the manner of forming or constructing the various parts of steam-engines herein mentioned, they forming no part of my invention, their nature and construction being well understood; nor do I claim any of such parts when uncombined with my improvements. Nor do I claim the processes of carbonating and hardening cast and wrought iron *generally, but only when applied to the* purposes herein set forth. And it should be understood, that although I have mentioned four or five hours for the process of carbonating the surfaces to be so treated, yet I do not confine myself thereto, as it will be evident, that should the said process be carried on for a less time, the carbonating effect would be only less deep or extensive, which, under some circumstances, may be desirable, and by carrying on the process for a longer time, then it will penetrate more deeply; but this must

depend on the workman and on the object to be effected. But I do hereby declare my invention to consist in carbonating and hardening the working surfaces of steam-engine cylinders, pistons, bearings, pumps, and cocks, as above described.*

BALANCE-SPRINGS OF CHRONOMETERS.

MR. E. I. DENT, of the Strand, has patented the following improvements in the construction of chronometers:—

It is well known, (says the inventor), that the delicate spiral balance-springs of chronometers and other time-keepers, and their adjustments, are exceedingly liable to injury from oxidation or rust, both during the progress of their manufacture and when in use, and whereby they are not only subject to decay, but their rates of going or accuracy of performance is very considerably varied from time to time. Now this said oxidation or rust may either be caused by the moisture ordinarily contained in the atmosphere, especially in the sea air in voyages, or in countries particularly exposed to its action. Nor are chronometers only liable to suffer from these causes, but also from the perspired matter and the breath of the workman during the progress of their manufacture. Now it is the chief object of my invention to prevent, as far as possible, the said oxidation or rust, by coating or defending those delicate parts of chronometers with a coating or varnish, sufficiently flexible to allow the perfect free action of the balance-springs, and yet capable of preventing the action of moisture or saline and other vapours to which they are liable to be exposed. And I hereby claim as my invention, and the object of this patent, the use and application of any fit and proper flexible defensive coating or varnish to the more effectual prevention of oxidation or rust in the balance-springs and adjustments of chronometers and other time-keepers. In order, however, to afford an example of the best means I am acquainted with for carrying my said invention into effect, I will describe the composition of such a varnish or coating as I have found to answer the purpose completely. I take half an ounce by measure of pure spirit of turpentine, and put to it forty grains of camphor, and also add ten grains of bruised gum copal to the said mixture; I then heat it nearly to its boiling point, and keep it in that state for two hours. I then filter the mixture through cotton, or other proper substance. This varnish should be kept in an air-tight bottle, closed by a glass stopper, the mouth of it being sufficiently large to admit the balance-spring and its adjustment, which are to be put into the bottle in a dry state, and free from oil or grease, and after being completely immerged in the varnish, are to be carefully drained before they are removed from the bottle. The balance-spring and its adjustment must then be placed into a temperature from 200 to 300 degrees of Fahrenheit's thermometer, and be kept therein from six to

* Repertory of Patent Inventions, No. 38.

eight hours. I would remark that in place of using pure spirit of turpentine and camphor, I prefer to use half an ounce of an oil found in portable gas reservoirs, when that oil can be obtained; but as portable gas is now but little employed, and is going out of use, the materials I have above described will be found to answer well, and may be readily obtained from chemists, care being observed in obtaining pure spirits of turpentine.

Having thus described my invention, and the best means I am acquainted with for carrying it into effect, I would wish it to be understood I do not claim a right to any mixture or processes for varnish making, but only to the application of any fit and proper and sufficiently flexible coating or varnish to the balance-springs and adjustments of chronometers and other time-keepers, and thus effectually protect the said balance-springs whilst under the different exposures of temperature during their manufacture, when moisture is likely to be deposited thereon, and also to resist atmospheric attacks, as well as the many damps and impregnated vapours to which the chronometers and other time-keepers are frequently subjected on shipboard, and particularly in tropical climates.

ADAMS'S EQUIROTAL CARRIAGES.

THERE have been lately exhibited some wheel carriages constructed on a principle which seems to us to possess great advantages over the wheel carriages now in use. They are called Patent Equirotal Carriages, and are suspended on regulating bow springs. The front wheels are as large as the hind ones. The springs are very flexible, and readily yield when the wheels are passing over obstacles. The two axles are capable of adjusting themselves by the traction of the carriage, either in parallel or radiating lines, with each other, according as the carriage advances, either on straight lines or curves; and thus the friction arising from the unequal tracking of ordinary carriages is avoided. In consequence of the frame work—technically called the "under carriage"—and, also, much of the iron work used in ordinary vehicles being dispensed with, and the springs reduced in weight one half, the total weight is materially lessened. When turning a corner, the weight is equally poised over the two axles, as when moving in a straight line. In ordinary carriages, the weight is frequently on three wheels, with the centre of gravity nearly over the base. In consequence of the power of radiation in both axles, sufficient friction may be obtained without injury to the carriage to arrest its motion down the steepest hill, or to stop it altogether on any slope without the aid of the cumbrous drag chain and shoe. The driver may by backing stop his horses on a hill-slope as easily as on a level. Owing to the peculiar mode of locking, the driver's seat turns

with the horses, and thus he is always square behind them when turning, with his full power exerted in a straight line, instead of losing his purchase by a side-way pull. The carriages may, if required, be so fitted up that all four wheels can, at the pleasure of the driver or sitters, be deprived of their free rolling movement, and converted into drags, in case of the horses running away. By the substitution of smooth turning centres, instead of the ordinary wheel plate and perch bolt, which rattle, and by the total absence of any other moving joints, such as spring bolts and shackles, and by the springs being each composed of a single plate of steel, they are very free from noise and concussion. They are also very easy to the sitters from the peculiar construction of the springs, which permit a universal action both laterally and vertically, and also in a direction with the advancing motion of the carriage. And, by the flexible braces, the vibrating motion so frequently complained of, is entirely removed.

We have seen several of them, which are elegant in form, and we think they are likely to answer the expectations of the inventor, and be of advantage to the public. The principle on which they are constructed is applicable to railroad carriages as well as those on common roads; and by enabling the two axles to adjust themselves with each other, either in parallel or radiating lines, will allow railroads to be safely and conveniently constructed in curves of comparatively short diameter, as well as in straight lines. The principle on which this is done seems to be the total separation of the axle of the fore wheels from that of the hind ones, so that each part moves freely on its own centre, while the connexion of the parts of the carriage is preserved independently of the perch or axletrees. Where the body of the coach admits of it, or when it is composed of two parts, each part may be said to have its separate pair of wheels, while the connexion between the parts is established by a ball and socket-joint, which admits of free yet safe motion.*

FOREIGN RAILWAYS.

Austrian.—The railroad near Vienna, called *Kaiser Ferdinand's Nordbahn,* or the Emperor Ferdinand's North-way, was partially opened on the 23rd of November, from Florisdorf to Wagram, a distance of one German mile and three quarters, or about eight English miles. An immense crowd, including all the fashionable world of Vienna, assembled to witness the novel and interesting spectacle. A train of eight passenger-carriages was formed, some conveying eighteen, and others twenty-four, the whole train one hundred and fifty individuals, and attached to a locomotive machine of thirty-horse power. The locomotive,

* Courier newspaper.

which was ordered from England, arrived at Vienna some months ago, and has since been a great object of curiosity to all the engineers and mechanicians of the capital, who express the most unbounded admiration of its construction. The passenger-carriages were, we believe, of native make, and are highly praised for their luxurious elegance. At ten o'clock precisely, the whole train moved off, to the enthusiastic delight of the spectators, and safely arrived at Wagram in twenty-six minutes, where it was turned round, and guided back to Florisdorf. The whole affair went off to the satisfaction of all parties. It is anticipated that early in December the line will be practicable as far as the Prater itself, the gigantic bridge over the great branch of the Danube being now nearly completed.

Dutch.—A pamphlet, by Mr. Donker Curtis, in favour of the extension of railways in Holland, has met with an opponent in the person of Mr. A. F. Bouricius, "Royal Prussian Titular Postmaster at Arnheim." Mr. Bouricius, in his pamphlet on the subject, even declares himself opposed to the railway already begun between Amsterdam and Haarlem, observing, that "in commerce Amsterdam is now no more a Liverpool than Haarlem is a Manchester." He considers that injury will be done to the capital already embarked in canals, treckschuyts, &c., and no counterbalancing advantages obtained by a mere increase in the speed of internal communications, the probable profits of which in Holland, he regards as totally inadequate to reimburse its promoters. We can only observe that the circumstances of Holland, with regard to canals, are certainly so peculiar, as to render the new improvement of less convenience to them than to any other state; but it would be a most singular spectacle, if, while almost all Europe and the thinly peopled States of America, are eagerly pressing forward to reap the advantages of this great discovery, one of the richest, most industrious, most commercial, and most thickly-peopled European communities were to remain inactive.

French.—Operations are carrying on with activity on the railroad from Montpellier to Cette. The road through the morasses of Vic and Frontignan, is already marked out, and that through the piece of water called "the Pond of Ingril," begun. The works are under the direction of an English engineer, Mr. Thos. Brunton. A railroad is projected from Montpellier to Nismes.

Italian.—The works are begun on the railroad from Naples, to Castellamare. The shares of this undertaking are 1,000 Italian *lire* each, or about 40*l.* sterling, each *lire* being equal to a French franc, or nearly ten pence English. The whole capital comprises eleven thousand of these shares, or eleven million of *lire*, about 440,000*l.* There is a great difference of opinion at Naples as to whether the undertaking will ever pay; but, we believe, little difference of opinion any where else.

Prussian.—The royal permission, or "concession," as it is technically called, for the formation of a railway from Magdeburgh to Leipzig, was received at Magdeburgh on the 24th of November, together with the law of expropriation, or permission to take possession of private landed property for the purposes of the railway, on the payment of an adequate compensation awarded to the proprietors, in the same manner as in the use of high-roads made by government. This permission is clogged with conditions, liberty to take possession of the whole concern, paying a compensation to the then existing shareholders; a measure which, of course, is certain to be adopted in case the undertaking should prove successful. Another is, that at the expiration of ninety years, the railway becomes unconditionally the property of the State. The new railroad is to pass through Kothen and Halle to Leipzig, where, by the time it is completed, it will find that from Leipzig to Dresden in full operation.*

THEORY OF THE SPINNING TOP.

(*From the Liverpool Mercury.*)

THE theory of the motion of the top has occupied, and has puzzled many able men. It is extremely difficult to say, why a top stands at all. I have heard the late Sir John Leslie say that the subject was one of the most difficult in Natural Philosophy. He had a very excellent one, running upon agate, for the same purpose as Troughton's. It spun a long time, but I am not certain as to the exact time. Dr. Arnott in his admirable, though not always correct work, on Physics, thinks he has discovered the true cause, and considers it so important as to point it out in the preface among his "specimens of new disquisition or suggestion." He very correctly points out, (p. 61, of the third edition), the futility of the cause usually assigned "even in philosophical treatises of authority." "Some persons believe," he says, "that a spinning top in a weighing scale would be found lighter than when at rest; and many most erroneously hold that the centrifugal force of the whirling, which of course acts directly away from the axis, and quite equally in all directions, yet, when the top inclines becomes greater upwards than downwards, so as to counteract the gravity of the top." This, though the current opinion, is no doubt erroneous enough; but, in attempting to give the true reason, the author falls into an error equally fallacious. "While the top," to use his own words, "is perfectly upright, its point, being directly under its centre supports it steadily, and, although turning so rapidly, has no tendency to move from the place: but if the top incline at all, the *side* of the peg, instead of the very point, comes in

* Railway Times; quoted in the Mechanics' Magazine, No. 750.

contact with the floor, and the peg then becomes a little wheel or roller, advancing quickly, and, with its touching edge describing a curve, somewhat as a skaiter does, until it comes directly under the body of the top, as before." This is liable to three objections: first, that a cylinder, inclined to one side, and rolling round upon one end, never would roll towards the centre, but rather from it: second, the cause would cease, and the top would immediately fall whenever any small hollow confined its point to one spot, as is frequently the case: and third, if the standing of the top depended on the width of the point, it would follow that, the finer the point the more difficult it would be to keep up the top, and if the peg could be ground to a mathematical point, the top would invariably and instantly fall: but the least observation shows that the tendency to fall is, in mathematical language, no function of the fineness of the point; who ever saw a top spin worse for having a fine point if the floor were sufficiently smooth and hard?

Before any attempt to give a theory of its motions, it would be well to observe carefully what those motions are—how far essential, and how far accidental—and also to institute experiments to discover in what manner the different motions are effected by a change of circumstances. We shall find, then, that a top has four distinct motions,—1st, a *rotary motion* on its axis, corresponding to the diurnal motion of the earth, and of course essential; 2nd, an *erratic motion*, corresponding partially to the earth's annual motion; this motion depends on the thickness of the point, and is, of course, not essential, since it may be confined: 3rd, a *conical motion of its axis*, in which the top of the axis slowly describes a circle altogether differing from the rotary motion, and keeping no time with it: it corresponds exactly to the well known conical motion of the earth's axis, completed in the long period of 25,000 years, and occasioning the precession of the equinoxes; this motion is slowest when the rotary motion is most rapid, and quickens as the latter diminishes; it is slowest, also, in those tops which have the shortest pegs, and ceases altogether when the centre of gravity is brought so low as the point of the peg: this motion is, of course, essential, so long as the centres of gravity and of motion do not coincide: there is also a fourth motion, which will almost invariably be found to some extent, though altogether contingent and depending, I suspect, upon the imperfection of the mechanism, viz., upon the load, and being equally poised on every side of the centre of motion: it is a minute circular movement of the axis describing a coil of very small circles around the circumference of the circle described by the third motion: it very prettily illustrates the motion called in astronomy the *nutation* of the earth's axis, except that it differs from it essentially in its rapidity, being concomitant with the first motion.

From what I have said it will appear that there is some

harmony between the motions of a top and those of the planetary bodies. Sneer at tops who will, the earth itself, as to its motions, is nothing else than a large spinning top; and any one attempting either to give or to obtain a clear idea of the various planetary movements will find the top a most useful auxiliary. It is remarked by Sir J. Herschel, in his volume on astronomy in Lardner's Cyclopædia,--(Art. 266),—that a "child's peg-top or te-totum, when delicately executed and nicely balanced, becomes an elegant philosophical instrument, and exhibits, in the most beautiful manner, the whole phenomenon, (of the precession of the equinoxes), in a way calculated to give it at once a clear conception of it as a fact, and a considerable insight of its physical cause as a dynamical effect." But, unfortunately for this purpose, the motion is always in the wrong direction, being *along with*, instead of *contrary to*, the direction of the rotary motion. The question arises, how is this to be accounted for, or can it be obviated? It appeared to me, that, since this motion is retarded by shortening the peg and lowering the centre of gravity, it would cease altogether if the centres of motion and of gravity were made coincident, and, upon further extending the same change, which gradually annihilated the positive motion, that motion would re-appear negative. I had, therefore, a top constructed with an axis capable of being raised or lowered at pleasure by means of a screw; it was made to spin in a very small glass cup, fixed on a narrow stem, and, a conical hole, cut in the bottom of the top, permitted the cup to be raised within the top above its centre of gravity. This I found exactly to answer my expectation, it permitted the motion to be quickened, retarded, annihilated or reversed at discretion, and, in fact, tamed its usual wild vagaries and brought them into perfect control. As it was confined to one spot, I could fix a wooden circle round it for the ecliptic, a thin rim of lead marking its equator. I could then make it spin with any degree of inclination of the two circles that I chose, and, by lowering the centre of gravity a little below the centre of motion, I could then show the conical motion of the axis and the two equinoctical points slowly moving in a *contrary* direction to the top, and taking as much as five or ten minutes to describe a single revolution. If the point is fine the inclination of the equator to the ecliptic will be preserved without any apparent diminution, but, if not, the inclination will gradually decrease until the top attain a vertical position.

By this means, with a few additional contrivances, we may illustrate almost every astronomical movement. The top, with its stand, may be carried where we please, or swung suspended by a long string, to show the earth's annual revolution, while the other motions are going on at the same time. The string will of itself almost invariably take an ecliptic rather than a circular orbit, and, if suspended from the hand, a delicate motion of the

finger will show the advance of the earth's apsides. If, again, we substitute for the body of the top two balls attached to each other or to a heavy ring, we may show the relative motions of the earth and moon, the retrogradation of the nodes and all the phenomena of eclipses. The volutions of the top, however, not only *illustrate* those of the planets, but appear to me to *depend upon the same causes*; and I am persuaded that the same theory on which they depend may be made even to explain, if not practically to illustrate, the hitherto unsolved problem of the eccentric revolutions of Saturn's rings and the stability of their equilibrium.

It may be remarked that I have not explained, after all, what I conceive to be the true cause of the top's standing, but I have been afraid of encroaching too far upon your space, and must reserve that for a future occasion, if my communication should be acceptable. In the meantime, if any one choose to construct a top such as I have described, and to remark the peculiar motions which I have pointed out, he will have taken the first step towards discovering for himself the real cause.*

AUTOMATON VIOLINIST.

After the extraordinary performance of Paganini and Ole Bull, our readers will not be surprised at any new developement of the powers of this instrument however great; but there are few in the world who will hear without wonder and admiration of the unequalled performance of Monsieur Marreppe's automaton violin player, which was recently exhibited before the Royal Conservatory at Paris. Our informant, M. Bruyere, who was present, thus describes this wonderful piece of mechanism:— On entering the saloon, I saw a well dressed handsome figure of a man, apparently between forty and fifty, standing with a violin in his hand, as if contemplating a piece of music which lay on a desk before him; and had I not gone to see an automaton, I should have believed the object before me to have been endowed with life and reason, so perfectly natural and easy were the attitudes and expression of countenance of the figure. I had but little time for observation before the orchestra was filled by musicians, and on the leader taking his seat the figure instantly raised itself erect, bowed with much elegance two or three times, and then turning to the leader nodded, as if to say, he was ready, and placed his violin to his shoulder. At the given signal he raised his bow, and applying it to the instrument produced *a la Paganini*, one of the most thrilling and extraordinary flourishes I ever heard, in which scarcely a semi-tone within the compass of the instrument was omitted, and this executed with a degree of rapidity and clearness perfectly astonishing. The orchestra then played a short symphony in which the automaton

* Quoted in the Mechanics' Magazine, No. 748.

occasionally joined in beautiful style; he then played a most brilliant fantasia in E. natural, with accompaniments, including a movement allegro mollo on the fourth string solo, which was perfectly indescribable. The tones produced were like any thing but a violin; and expression beyond conception. I felt as if lifted from my seat, and burst into tears, in which predicament I saw most persons in the room. Suddenly he struck into a cadenza, in which the harmonics double and single, arpeggios on the four strings, and saltos for which Paganini was so justly celebrated, were introduced with the greatest effect; and after a close shake of eight bars' duration, commenced the coda, a prestissimo movement played in three parts throughout. This part of the performance was perfectly magical. I have heard the great Italian, I have heard the still great Norwegian, I have heard the best of music, but I never heard such sounds as then saluted my ear. It commenced *p p p*, rising by a gradual crescendo to a pitch beyond belief; and then by a gradual motendo and colendo died away, leaving the audience absolutely enchanted. Monsieur Marreppe, who is a player of no mean order, then came forward amidst the most deafening acclamations, and stated that emulated by the example of Vaucouson's flute player, he had conceived the project of constructing this figure, which had cost him many years of study and labour before he could bring it to completion. He then showed to the company the interior of the figure, which was completely filled with small cranks, by which the motions are given to the several parts of the automaton at the will of the conductor, who has the whole machine so perfectly under control, that Monsieur Marreppe proposes that the automaton shall perform any piece of music which may be laid before him within a fortnight. He also showed that to a certain extent the figure was self-acting, as on winding up a string, several of the most beautiful airs were played, among which were "Nel cor piu," "Partant pour la Syrie," "Weber's last Waltz," and "La ci d'arem la mana," all with brilliant embellishments. But the *chef d'œuvre* is the manner in which the figure is made to obey the direction of the conductor, whereby it is endowed with a sort of semi reason."*

DR. CLANNY'S IMPROVED TELEGRAPH.

No machine for making signals or numerical symbols can, with propriety be called a Telegraph, unless it be adapted to express a sufficient number of letters so as to form words, not only in one, but also in every written language, and by which words and sentences may be formed expeditiously. We have much pleasure in stating to our readers that Dr. Clanny, of Sunderland,

* Galignani's Messenger; quoted in the Mechanics' Magazine, No. 748.

has so improved his Telegraph, that the advantages hinted at above are now completed, and at the trifling expense of fifty shillings for each station, if the station be ten or even twenty miles. This Telegraph is not to be patented.*

GUNPOWDER ENGINE.

After years of labour, and many disappointments, sustained only by patience and perseverance rarely equalled, Mr. J. Smith, of Dysart, has completed a machine, which he terms a gunpowder engine, and which moves with great ease against a weight of twenty-six hundred weight on the square inch of the piston equal to a column of water a mile and a quarter high. And yet, with this enormous power, the machine is so perfect that not a particle of leakage proceeds from any part of it. Nor is it possible to increase this power by any effort of the person to whose care the machine may be entrusted—a circumstance which renders it perfectly safe. Mr. Smith calculates the saving in the use of his machine as compared with steam, to be fully eighty per cent., whilst the space it occupies is not one-twentieth of that taken up by the steam-engine.†

THE CUBA RAILWAY.

We have been furnished by a correspondent with the following account of the railway which has been constructed across the island of Cuba by the government of that island, and which is about to be completed and opened in a very short time.

This railway passes from the city of Havannah to the port of Batabano, on the southern side of the island of Cuba, and is eighty miles in length. The purpose for which it has been constructed, is to connect the commerce of the Havannah and the northern side of the island, and also the commerce of New Orleans and various other important parts of the northern side of the Gulf of Mexico, with the West India islands and the Spanish Main. Cuba being an island of upwards of 700 miles in length, but only about eighty miles in its average breadth, and lying in a position which requires vessels from the north or the south to sail round it in order to reach the opposite sea, it was projected by the present governor of the island, that a railway should be formed for the purpose of cutting off a navigation of several days, by passing across the island from north to south. It is therefore apparent that the railway is a work of the most important kind, and will tend to improve most materially the commerce, not of

* Newcastle Journal; quoted in the Mechanics' Mag. No. 748

† Caledonian Mercury; quoted in the Mechanics' Magazine, No. 748.

the island of Cuba alone, but of the English West Indian islands, and of all the countries of the West Indian seas.

The railway is not perfectly direct in its course from the Havannah to Batabano; as, in the commencement of the undertaking, it was thought expedient to carry the line a few miles eastward of the due course across the island, for the purpose of taking in some very rich and populous villages and sugar plantations which exist upon the way. This deviation, however, will serve as a branch, should the traffic upon the railway prove equal to the expectations of the government, and the course, at a future time, be required to be rendered perfectly direct from sea to sea.

Fifty miles of the line have been completed some months since, and a steam locomotive engine, of great power and size, has been manufactured for it, by the Messrs. Braithwaite, of the New Road. The whole of the levels and other more important works upon the remaining thirty miles, are now also completed; and the rails having been shipped from England about two months since, it is expected that the next arrivals from the Havannah will communicate the intelligence of the opening of the entire line.

Seeing that a railway of so great a magnitude is thus about to be completed, in so comparatively improbable a situation as the island of Cuba, let us hope that the governments of the neighbouring English West Indian islands will profit by the spirited example of the Spaniards, and proceed to construct similar works in many localities amongst the islands, where outlays of money for such purposes would be much more certain of being repaid than in any of the colonies of Spain.*

AMERICAN RAILROADS.

A SINGULAR and wonderful feature of America is her vast and increasing extent of railroads. While the English have almost stood still, contemplating with great complacency the two or three which they have made, the Americans have laid down two thousand miles of railroads, many of them as good for all practical purposes as the Liverpool and Manchester. Many circumstances conspire to assist the Americans in the construction of these roads—the alluvial plains, which often present a dead level for a hundred miles together, the great plenty of timber, and, more than all, the non-appropriation of the ground, which enables the projectors to buy it for a trifle, and, in the majority of cases, to get it for nothing. They have pushed these roads into the very bosom of the wilderness. Like the military roads of the Romans, they hold steadily and straight on through plain

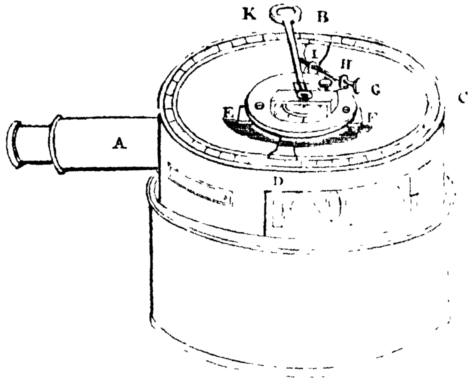
* Railway Times; quoted in the Mechanics' Mag. No. 746.

and morass, through lane, forest, and river, and across the rugged Alleghanies, and the wild woods that skirt the banks of the Mohawk: and where a few years since an Indian hunter could scarcely force his way, you now dash along at the fearful velocity of twenty miles an hour. Many of these roads have been finished for less than 5,000 dollars a mile; the very best of them made of English iron, and laid down on stone sleepers, have been completed for 29,000 dollars a mile, or about 6,000*l*., which is only one-seventh the cost of the Liverpool and Manchester. The same method and dexterity which marks their steam-boat travelling, is also seen here: the engines are nearly all of American construction, having superseded those imported from England, and the engineers seem to have them under better control. There is certainly no unnecessary expense about these railroads. The sleepers are often not filled up, and frequently, in passing a deep chasm, or rushing torrent, the bridge is only just wide enough for the rails. Most of these railroads are at present single tracks, which occasion delay when trains meet. The carriages are larger than ours, they are sometimes fifty feet long, and have a deck with verandas. I have often remarked, that American engineers seem more dextrous than English. I have seen a train going seventeen miles an hour stopped in forty yards. The engine carries a large shovel in front, which removes any obstacle lying on the rail. Riding on the engines of a Washington train at night, I saw a cow lying on the rails; before I could exclaim, we were upon her, and I expected a shock, instead of which, the shovel picked her up, carried her a few yards, and then threw her to the roadside, out of the way. I took many opportunities of riding on the engines—wood is burned in most of them—anthracite coal in few. Their cylinders are mostly horizontal, like our own; but I saw several where the cylinders were vertical. There is a fine road from Albany, on the Hudson, to Utica, ninety miles This road in a few months will reach to Buffalo, on the Lake Eri, and then a traveller may pass from New York to Niagara, in twenty-four hours. There are railroads throughout all the New England States to every town of importance, and some thousand miles in progress in the South and West. There is the least improvement in the slave States. There is no country where you can cross such vast tracts in so short a time as in America, and the facilities are every day increasing. The Ohio already joins the Delaware, by a railroad 350 miles long, and in a few years, a traveller may be able to pass from the Gulf of Newfoundland to the Gulf of Mexico—from icebergs to orange-groves—in six days.*

* Leicester Mercury; quoted in the Mechanics' Mag. No. 746.

NEW POCKET-BOX CIRCLE.*

By William Galbraith, Esq., M. A., Teacher of Mathematics, Edinburgh, M. S. A.



(Galbraith's New Pocket-Box Circle.)

In the early ages of the world, the instruments for making astronomical observations being very rude, the results obtained by them were far from accurate. In the days of Hevelius and Flamsteed, large sectors of many feet radius were employed; and, though divided to a very great degree of precision, yet being only parts of the circle, did not possess that accuracy which might have been obtained by employing the whole circle. At a much later period, quadrants were used at Greenwich, Oxford, and in most of the continental observatories; and, from the accuracy of their construction by Graham, Bird, Ramsden, and Troughton, important results for the advancement of astronomy were derived from the labours of those astronomers to whom they were entrusted.

The first meridian transit circle, so far as we know, was that of Horrebow, constructed about the year 1735. The next, that of Mr. Francis Wollaston in 1793, made by the late Mr. Cary, though Ramsden had made the Palermo altitude and azimuth circle in 1789, and the Dublin circle some years afterwards, both of which have rendered essential services to astronomy. These were all of great size, and fitted for fixed observatories only. A smaller, and more portable circle, was still required to supply the wants of amateur astronomers and scientific travellers. Mayer of Göttingen first contrived an instrument by which he could diminish the errors arising from bad di-

* Read before the Society of Arts for Scotland, 26th of March, 1836. The silver medal, value ten sovereigns, awarded 7th of December, 1836.

viding, by the principle of repeating the measurement of an angle over the whole, or at least, a great part of the circumference. Shortly afterwards, Borda invented his celebrated repeating astronomical circle, and his repeating reflecting circle, of which so much use has been made on the Continent, and to which such extravagant eulogiums have been paid by the continental observers. Undoubtedly, the results obtained by means of these instruments, particularly the former, are in many instances remarkable for their accuracy, considering their moderate dimensions. In fact, all the operations, astronomical and geodetical, required in the determination of the French arc of the meridian, were made by Borda's repeating circles of about eight inches radius; while in the British trigonometrical survey, the astronomical observations were chiefly taken by a zenith sector of eight feet radius, and the terrestrial by a theodolite of eighteen inches radius; and it is at this moment difficult to say, notwithstanding the disparity of the dimensions of these two classes of instruments, which of those two grand operations have been executed with the greater accuracy. Instruments of moderate dimensions, capable of repeating the observations frequently in a short space of time, seem by these, and other instances that might be produced, to approach the accuracy of the larger instruments much more nearly than might have been anticipated.

A reflecting circle was constructed by Bird for Admiral Campbell, chiefly from the description of one invented by Mayer, contained in his Tabulæ Solis et Lunæ, published at London in 1770. This was the first reflecting circle to which the repeating principle was applied. It was also the opinion of the inventor that a circle could not be divided at that time to a greater accuracy than three minutes, the dividing engine not being then in existence, and for these reasons sixteen inches was fixed upon as the diameter of this circle, which Bird, in the actual construction, exceeded by an inch and a half. The consequence was, that the circle became far too heavy to be used in the hand, either at sea or land.

This circle was divided as usual into 360°, and therefore it was necessary to double the angle read off from the instrument, as required by the principles of optics, on account of the double reflection at the index and horizon glasses. To avoid the trouble of doubling, these instruments have, for many years, been divided into 720°, or the space on the arc equal really to half a degree, is now reckoned a whole degree.

Admiral Campbell having found the instrument, on account of its weight, unmanageable at sea as a repeating instrument, confined his observations to a part of the limb that was found to be most perfectly divided. This gave rise to the construction of the sextant, which was lighter and more easily managed. These advantages, however, were gained at the expense of su-

perior accuracy. From the principles of construction, a circle with three verniers has the errors of centering, division, reading, glasses, &c., all either exactly, or nearly corrected; while in the sextant the accuracy depends almost entirely upon the abilities of the artist. Now, we think it cannot be doubted that the principle of correcting errors by mechanical means is much to be preferred to trusting to the character and abilities of the artist, however excellent both may be. For this purpose, even Troughton himself, with all his skill and ability as an artist, contrived a somewhat large reflecting circle of about eight or ten inches in diameter, and the same thing has been done by Dollond, Borda, Mendoza Rios, Hassler, &c. For many purposes these are too large and heavy, especially for travellers, surveyors, &c. who have generally had recourse to the pocket-box sextant, which is subject to the same errors as the larger sextants already alluded to; and to avoid these, I, many years ago, proposed to Troughton, the idea of forming a small pocket-box circle, similar to the one which I now produce, and in which very little of the diameter is lost in forming the radii to which the verniers are attached. Indeed, had the circular box been formed into a sextant instead of a circle, having an index carrying a single vernier, the length of that index would not have greatly exceeded those of the circle, on account of the space required for centering, and the segment cut off by the divided arc, and consequently little advantage would by that means be gained from greater length of radius.

Being unable to induce Troughton to enter into my views, I then attempted to get the late Captain Cater to patronise it, but without effect. I admit the good qualities of Troughton and Dollond's circles for many purposes, though I am also aware that their bulk, weight, and high price, are too many insuperable objections. I am also willing to grant to Kater's small portable circle all its merits as a travelling instrument on land, and I at this time possess one of the very best that Robinson has hitherto constructed, having both its horizontal and vertical circles six inches diameter, with three verniers, each showing 10″, and from the experience I have had, it promises to give, when properly managed, very accurate results. My object however, was, by means of the new pocket-box circle, to furnish observers with a very convenient, small, portable instrument that might answer every useful practical purpose at sea as well as on land, when accompanied by one of the simplest and most convenient artificial horizons.

By the able assistance of Mr. John Adie, I believe I have succeeded in constructing this little circle in a satisfactory manner, though in some of the minor details it may yet be simplified and improved, and I shall feel much pleasure should it meet with the good opinion of this Society, and shall gratefully adopt any suggestions of its intelligent members for accomplish-

ing its future improvement, and bringing it more nearly to such a degree of perfection as it may be susceptible of. The three verniers read each to minutes only, but as observations must always be taken, from the nature of its construction, twice —once forward and once backward—a mean of six readings will be obtained, giving a probable error not exceeding 20″ or so, for each double observation. By repeating these two or three times when thought necessary, it is obvious a much greater degree of accuracy will be obtained, than, from the small size of the instrument, might naturally be expected. Its convenient form, the ease with which it may be used, and the accuracy of its results, will, it is hoped, recommend it to a numerous class of observers, while its moderate price will enable many to become purchasers.

My remarks relative to the advantages derived from the use of two or three microscopes or verniers, are derived chiefly from an excellent analysis of the error to which astronomical circles are liable, in a paper by Dr. Robinson of Armagh, read before the Royal Irish Academy in 1825, and, if I am not mistaken, published subsequently in a separate pamphlet, so that it appeared to me unnecessary now to enter upon another discussion on this subject.

The learned author shows that "two microscopes will correct for eccentricity, or for any other error varying by a similar law; as also for all errors which are as the odd powers of the sine or cosine, but that three verniers are still better, failing only where the number expressing the order of the error is divisible by three."

In the original circle exhibited to the Society of Arts for Scotland, there are three verniers, but in the figure given here there are only two, though either mode may be followed by the maker when desired. In this figure A B C D is the circle divided into 720°, A the telescope, B, D, the two opposite verniers reading to minutes, or half minutes, if thought necessary, K the reading microscope or lens, G I the tangent screw fixed at any required position on the elevated circle E F H by a clamping screw near H. From this description, the method of making and using the circle will readily occur to those acquainted with the sextant.*

EXPLOSION OF STEAM BOILERS.

THE question whether any explosive gas is ever formed in a boiler, is as unsettled as ever. M. le Baron Seguier is on the affirmative side, and states that a M. Maiqué, of the Fauxbourg St. Antoine, absolutely kindled some gas, which issued at the safety-valve of his boiler, having previously perceived an odour which made him believe that hydrogen was escaping from it.

* Jameson's Journal, No. 44.

M. Seguier does not pretend to account for the hydrogen, being uncertain whether it arose from the decomposition of the water(?) or from that of some extraneous substance introduced into the boiler along with it. However this may be, the baron, in common with most English engineers, acknowledge that the principal, and nearly sole cause of explosions arises from the sudden generation of a large body of steam, in consequence of the water coming in contact with the overheated sides of the boiler. Considering the question, therefore, as of no moment in a practical point of view, it is still a proper object of experiment, to ascertain, whether decomposition of the water can ever be effected, or whether a disengagement of explosive gases may arise from that of extraneous matters, liable to be introduced into the boiler with the water.*

RESULT OF USING HOT-AIR BLASTS IN THE REDUCTION OF IRON.

During the first six months of the year 1829, when all the cast-iron in Clyde Iron works was made by means of the cold blast, a single ton of cast-iron required for fuel to reduce it 8 tons 1¼ cwt. of coal converted into coke. During the first six months of the following year, while the air was heated to near 300° Fahr., one ton of cast-iron required 5 tons 3¼ cwt. of coal, converted into coke. The saving amounts to 2 tons 18 cwt. on the making of one ton of cast-iron; but from that saving comes to be deducted the coals used in heating the air, which were nearly 8 cwt. The net saving thus was 2½ tons of coal on a single ton of cast-iron. But during that year 1830, the air was heated no higher than 300° Fahr. The great success, however, of those trials, encouraged Mr. Dunlop and other iron masters, to try the effect of a still higher temperature. Nor were their expectations disappointed. The saving of coal was greatly increased; insomuch, that about the beginning of 1831, Mr. Dixon, proprietor of Calder Iron-works, felt himself encouraged to attempt the substitution of raw coal for the coke before in use. Proceeding on the ascertained advantages of the hot blast, the attempt was entirely successful; and since that period, the use of raw coal has extended so far as to be adopted in the majority of the Scotch Iron-works.

The temperature of the air under blast had now been raised so as to melt lead, and sometimes zinc, and therefore was above 600° Fahr., instead of being only 300°, as in the year 1830.

The furnace had now become so much elevated in temperature, as to require around the nozzle of the blowpipes, a precaution borrowed from the finery furnaces, wherein cast-iron is converted into malleable, but seldom or never, employed where cast iron is made by means of the cold blast. What is called the *Tweer*, is the opening in the furnace to admit the nozzle of the blowpipe.

* Magazine of Popular Science, No. 22.

This opening is of a round, funnel-shape, tapering inwards, and used always to have a cast-iron lining, to protect the other building materials, and to afford them support. This cast-iron lining was just a tapering tube nearly of the shape of the blowpipe, but large enough to admit it freely. Now, under the changes I have been describing, the temperature of the furnace became so hot near the nozzles, as to risk the melting of the cast-iron lining, which, being essential to the *tweer*, is itself commonly called by that name. To prevent such an accident, an old invention called the *water-tweer* was made available. The peculiarity of this tweer consists in the cast-iron lining already described being cast hollow instead of solid, so as to contain water within; and water is kept there, continually changing as it heats, by means of one pipe to admit the water cold, and another to let the water escape when heated.

During the first six months of the year 1833, when all these changes had been fully brought into operation, one ton of cast-iron was made by means of 2 tons 5¼ cwt. of coal, which had not previously to be converted into coke. Adding to this 8 cwt. of coal for heating, we have 2 tons 13¼ cwts. of coal required to make a ton of iron; whereas in 1829, when the cold blast was in operation, 8 tons 1¼ cwt. of coal had to be used. This being almost exactly three times as much, we have, from the change of the cold blast to the hot, combined with the use of coal instead of coke, *three times as much iron made from any given weight of splint coal.*

During the three successive periods that have been specified, the same blowing apparatus was in use, and not the least remarkable effect of Mr. Neilson's invention has been the increase in efficacy of a given quantity of air in the production of iron. The furnaces at Clyde Iron-works, which were at first three, have been increased to four, and the blast machinery being still the same, the following were the successive weekly products of iron during the periods already named, and the successive weekly consumption of fuel put into the furnace, apart from what was used in heating the blast:—

	Tons	Tons	Tons
In 1829, from 3 furnaces,	111 Iron	from 403 Coke,	from 888 Coal.
In 1830, from 3 furnaces,	162 Iron	from 376 Coke,	from 836 Coal.
In 1833, from 4 furnaces,	245 Iron		from 554 Coal.

Comparing the products of 1829 with the products of 1833, it will be observed that the blast, in consequence of being heated, has produced more than double the quantity of iron. The fuel consumed in these two periods we cannot compare, since in the former coke was burned, and in the latter, coal. But on comparing the consumption of coke in the years 1829 and 1830, we find that although the product of iron in the latter period was increased, yet the consumption of coke was rather diminished.

Hence the increased efficacy of the blast appears to be not greater than was to be expected, from the diminished fuel that had become necessary to smelt a given quantity of iron.

On the whole, then, the application of the hot blast has caused the same fuel to reduce three times as much iron as before, and the same blast twice as much as before.

The proportion of the flux required to produce a given weight of the ore, has also been diminished. The amount of this diminution, and other particulars, interesting to practical persons, appear in a tabular statement supplied by Mr. Dunlop.

The blowing-engine has a steam cylinder of forty inches diameter, and a blowing cylinder of eight feet deep and eighty inches diameter, and goes eighteen strokes a minute. The whole power of the engine was exerted in blowing the three furnaces, as well as in blowing the four, and in both cases there were two tweers of three inches diameter to each furnace. The pressure of the blast was 2½ lbs. to the square inch. The fourth furnace was put into operation after the water-tweers were introduced, and the open spaces around the blowpipes were closed up by luting. The engine then went less than eighteen strokes a minute, in consequence of the too great resistance of the materials contained in three furnaces to the blast in its passage upwards.

Materials constituting a Charge.

		Cwt.	qrs.	lbs.
1829.	Coke	5	0	0
	Roasted Ironstone	3	1	14
	Limestone	0	3	16
1830.	Coke	5	0	0
	Roasted Ironstone	5	0	0
	Limestone	1	1	16
1833.	Coal	5	0	0
	Roasted Ironstone	5	0	0
	Limestone	1	0	0

Trans. Royal Soc. Edin.

IMPROVED CAMERA LUCIDA.

In August last, it appears that M. Kruine presented to the *Académie des Sciences* an improved form of Wollaston's camera lucida, in which, instead of the solid glass prism, used in the original instrument, a small mirror is employed, set at an adjustable angle to a horizontal piece of plain glass. The image of the object is reflected from the inclined mirror down to the plain glass, and from thence again to the artist's eye, he looking through a space left for the purpose, at the line in which the planes of the two glasses would meet if prolonged. The second reflected image is referred to the paper beneath, and the transparency of the plain glass allows of the point of the pencil being distinctly seen, thus enabling the draughtsman to trace the outline of the object. The merit of this construction is, that it re-

quires none of that effort to render both the pencil and image visible, one or the other disappearing, unless the eye were held very steadily at the hole applied to the edge of the prism, in the original instrument.

Mr. Parlour had some months previously constructed a camera lucida on this improved principle; at least, we have seen one deposited by that gentleman in the Gallery of Practical Science, and can bear testimony to its efficacy, for the purpose it is intended for. In Mr. Parlour's instrument, the plain glass is deeply tinged red, thus rendering the reflected image more distinct, by toning down the whiteness of the drawing-paper seen through it.*

BRIDGE OVER THE NILE.

The gigantic bridge over the Nile, projected a long time since, is at last about to be realized, and it is supposed it will be completed in six years. This remarkable work will be constructed at the point of the Delta, five leagues below Cairo. Since, in winter, and during part of the spring, the water in the river is at present much too low to be available for the purposes of irrigation, the bridge will be constructed so as to serve for a dam to keep the water up to the requisite height. The cultivator will thus be spared great labour and anxiety, and will only have to divert the water into the several canals of irrigation.

It has been calculated that at first 24,000 workmen will be required to change the bed of the river, to raise the dikes, and dig the lateral canals; 340 non-workers and 650 carpenters are to be drafted from the arsenal at Alexandria. As it will not be easy to find so many workmen in Egypt, four or five regiments will be employed at these works. The stone will be brought on an iron railroad from the Mountains of Mokatam, two leagues from the Nile.—(*Echo du Monde Savant*, 12th of August.)

If the foregoing statement be authentic, it is a fresh proof of the injudicious attempts now making by its present ruler to outrun the rational advance in improvement of which this fine country is really capable. Under different moral conditions of every kind, he is copying the ambitious project of a Peter the First, without possessing either his judgment or means.†

BENNET'S STEAM ENGINE.

A model of an engine, constructed upon the principles of those which are to be employed in propelling Captain Cobb's steamer between New York and Liverpool, has been exhibited at the Repository of the Institute.

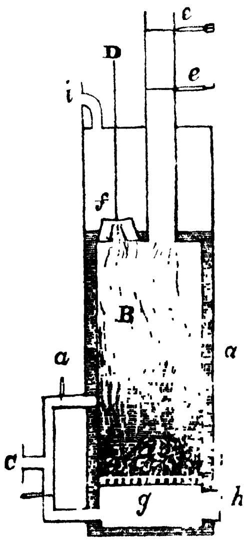
The examinations have resulted in a general conviction that the world is about to realize a new improvement, not inferior to

* Magazine of Popular Science, No. 22. † Ibid.

that of Watt and Bolton—an improvement that will effect a new era in ocean navigation, and bring all parts of the world in approximation to each other. A voyage to Liverpool, it is believed, may, by the power of this engine, be accomplished in ten days, with one-tenth of the fuel heretofore required.

We have requested Mr. Bennet to give a minute description, accompanied with a drawing, which, we hope, will enable the readers of the Journal who have not visited the Repository, to comprehend what to us was incomprehensible, till we examined the model, and heard the explanation, how the fire and the water could be brought and continued in actual contact with each other, and, rapidly generating the steam, still kept in control, and its potency safely directed to propel the car or the ship.

The following is the description which Capt. Bennét has been so obliging as to prepare for us:—



(Bennet's Steam Engine.)

The engine for the Liverpool packet, is a double horizontal high pressure engine, 35 inch cylinder, 6 feet stroke with two blowing cylinders, of half the capacity, worked by the piston-rod of the steam cylinder passing through the lower or extreme head, and into the blowing cylinders; consequently, both will be of the same motion. Pipes C, with the necessary valves attached to the blowing cylinders, convey the air to the steam generator, whose outer case, *a a*, is 4 feet diameter, and 12 feet high, and the inner case, or furnace B, is 3½ feet diameter, and 9 feet high. Smoke and feed-pipe D, is constructed with two slides, *e e*, which closes the pipe perfectly tight when thrust into it; their uses will hereafter be explained; *f* is a cap-valve in the steam chamber, placed over a short pipe or nozzle on the upper head of the furnace, and fitted to its seat perfectly tight, with a rod extending through the upper head of the outer case; *g* is the ash-pit below the grate; *h* an opening into the ash-pit, with a slide to close it tight, when necessary.

In order to put the engine in operation, and successfully use all the advantages of this generator over any other, it will be necessary to set open the feed and smoke-pipe D, and the pipe *h*, as now represented; to introduce fuel down the feed-pipe, in sufficient quantity, and ignite it. Previously fill the space between the outer and inner case with water up to the dotted line, half way up the cap-valve *f*, which will completely immerse the furnace; and when steam is generated of sufficient elasticity to start the engine, say 75 lbs. per square inch, close the pipes D and *h*, with their respective slides; then start the engine in the usual way, by opening a communication with steam-pipe *i*; then the blowing cylinders will force their charges of air through the pipe C into furnace B, partly

taking its course through the mass of fuel on the grates, a sufficient quantity being introduced above the fuel to burn the smoke, which can be regulated by slides in the branch pipes, terminating the air-pipe C. You will discover that there is no escape for the air thus forced into the furnace until its elasticity is, by the continued blast from the blowing cylinders, a little superior to the steam in the steam-chamber, when the cap-valve *f* will rise from its seat, and the air, flame, and gases arising from combustion, will be forced to pass under the edges of the said valve out into the water; and in this process, all the heat generated will be imparted to the water, without the possibility of escaping otherwise.

By the repeated experiments I have heretofore made, I find that one foot of air blown into the furnace to promote combustion, by the expansion it undergoes, and by the addition of the gases and steam, is augmented in bulk at least five times its original size, or, to speak briefly, there is five times as much compound steam, as air, forced into the furnace; consequently, it will take one-fifth part of the power of the steam to operate the bellows, plus the friction, or this is nearly the power; but I forbear at present, nor is it necessary, to speak at large on that subject in this paper.

By a careful examination it will be seen, that the pressure of steam will wholly depend upon the proportion of the size of the blowing cylinder to the steam cylinder. In my engine now building, the blowing cylinders each contain 20 cubic feet; the steam cylinders, each 40 feet; but the steam being cut off when the piston has made but one half its entire stroke,—which reduces its size, as a measure to deal out the steam, to exactly the size of the blowing cylinder—the measure of the air forced in by the blowing cylinders being augmented, by passing through the generator, to five times its bulk, has to be forced into a space in the steam cylinder of just its original bulk; it will, therefore, exert a force equal to five atmospheres, which will be 60 lbs. to the square inch above the atmospheric pressure.

This force, per inch, will not be exerted during the whole length of the stroke of the piston, but only half way, or to where the steam is cut off; and at the end, its elastic force is reduced to about 20 lbs., which will make the average pressure 50 lbs. per square inch, and the piston contains 962 square inches, which multiplied by 50, will produce 48,100 lbs., the whole average force the piston moves with. It is calculated to have the engine make thirty-five double strokes per minute; hence, the piston will move 420 feet per same time, which multiplied by 48,100, produces 20,202,000 lbs.; the weight that the piston would lift one foot high per minute, divided by 33,000, being what a horse power is estimated at, gives 612 horse power for each steam cylinder. But the power abstracted to operate the blowing cylinders, and overcome the friction, I allow nearly equal to the power of one of the cylinders; therefore, I estimate the power of the engine at 612 horse power.

The amount of fuel consumed, will depend upon the amount of air forced into the furnace by the blowing cylinders; and my two blowing cylinders, at every revolution, would force in 80 feet, if there were no leak either in piston or valves, and no space between said piston and valves for the air to compress in, and not be wholly forced out; therefore, probably not more than 75 feet will be expelled each revolution of the engine; and as it takes all the oxygen contained in 175 feet of atmospheric air to burn one pound of carbon, and 525 feet to burn one pound of hydrogen, I am of opinion, that to allow 225 feet to be necessary to

burn one pound of fuel, will not be allowing too much; and, as before stated, 75 feet will be forced into the furnace at each revolution, it will therefore take three revolutions to burn one pound; and as a cord of yellow pine weighs about 2,100 lbs., it will take 6,300 revolutions to burn one cord, which, divided by 35, the motion of the engine per minute, will give three hours for each cord, which, compared with the engine of the steamer *Erie*, on the Hudson, of little less or nearly the same power (600 horse power), will consume forty cords in ten hours, or twelve cords in the same time my engine will one cord.*

NOVEL AND INGENIOUS METHOD OF PRINTING DISCOVERED IN AMERICA.

A BOARD of any hard wood of an even and close grain, such as box, pear, plum, or walnut, but cut the cross-way of the grain, is made truly level and smooth. Characters, letters, or patterns, at pleasure, are stamped about one-fifth of an inch deep, by means of steel punches, and when the page is completed, the surface is planed down again smooth and level, till the letters are just effaced. The wood is then soaked in hot water, which causes the woody fibre to expand again, which had been compressed by the punches. The result is, that the letters rise up in relief, and impressions can be taken from the board as from a stereotype plate. Blocks prepared in this way may be used for stamping paper-hangings, or calico, if the characters should not be sharp enough for printing letters.†

CANAL-BOAT EXPERIMENTS.

M. HAINGUERLOT, last July, instituted some experiments on the Canal de l'Ourcq, which fully confirmed the result of those made by John Macneill, Esq., on the Paisley and Glasgow canals. It may now be considered as ascertained,—

1. That the wave formed by the boat pushing the water before it, moves with a velocity dependent on the section of the canal, and this may be determined in each case by observation, though it depends on hydro-dynamical principles not yet well understood.

2. That while this wave moves with a velocity greater than that of the boat, and therefore precedes it, the wave opposes a resistance to the boat's advance, inversely proportioned to the distance between them.

3. That the minimum of tractive power is required to draw the boat when the velocity of this is sufficiently augmented as to

* In the *Mechanics' Magazine*, this engine is represented as "a new but by no means improved edition of the blast-engine of Messrs. Braithwaite and Ericsson, which proved in its application to steam-vessels a failure, for the same reason that his will assuredly fail also,—the rapid clogging up with clinkers, and wasting of the fire-bars, through the intensity of the heat, to which they are subjected." Of this result, however, we are not aware that evidence has been adduced.

† Magazine of Popular Science, No. 22.

cause the boat to mount on the top of the wave, and to move along with it.

The Canal de l'Ourcq is thirty-six feet wide at the water level, and about a yard and a half deep. The boat was made in England; it was of thin sheet iron, seventy-five feet long, and six wide; two horses were employed to tow it, and the tow-rope, its situation, and the mode of fixing to the horses, were imitated from those adopted by the English engineers, in the celebrated experiment alluded to.*

HANCOCK'S PATENT CAOUTCHOUC BOOKBINDING.

WHILE numerous very important improvements have recently taken place in every other department of the mechanics of book making, that part of binding, which consists of attaching the leaves together, has hitherto remained stationary, if indeed it has not retrograded. That this want of progress in the march of improvement, is not to be ascribed to any perfection in the art as usually practised in the present day, will readily be admitted by every one who is familiar with its details, who has a library, reads a book, or is in the practice of making entries in ledgers or other account books. Mr. Hancock, in his patent process of binding books with caoutchouc, or India rubber, (an article which has made such rapid strides in usefulness within these few years,) is the first that has effected any improvement in the operation in question; and that improvement is a most important one. The qualities of caoutchouc, its elasticity, its adhesiveness, and its being impervious to the ravages of damp and insects render it an article admirably adapted for the purpose to which it has in this instance been applied; and we think there is little doubt, but that it will in a short time totally supersede the use of stitching, paste, and glue.

Mr. Hancock's invention consists in the binding of the leaves of books together by a solution of caoutchouc, or India rubber, by various methods, the books being composed of either single leaves, or sheets of any number of folds; dispensing altogether with the operations either of stitching, sewing, or sawing-in, and of the use of paste or glue in the backs. Instead of the leaves only being bound together by stitches at two or three points, the caoutchouc takes hold of the whole length of the leaf, in some of the varieties of Mr. Hancock's patented methods, and of a greater portion of it in others. The caoutchouc may also be used in conjunction with stitching, a back, however formed in this way, although of course stronger than with the caoutchouc alone, will not open quite so freely.

The advantages resulting from the adoption of Mr. Hancock's patent caoutchouc bookbinding are numerous;—the following are stated by the patentee, to be amongst the most obvious. As

* Magazine of Popular Science, No. 22.

regards books for the library—bound in the patented manner, they will open with much greater facility, and when opened, lie perfectly flat, or more nearly so than books bound in the ordinary way; thus preventing all strain on the backs, as well as obviating the necessity of keeping the leaves apart by force while reading, either with the hand, a weight, or otherwise.

In many extensive public and private libraries, the ravages of the insect produced in the paste, and by damp, have been most troublesome and destructive. Caoutchouc is impervious to both these evils. As regards collections of costly engravings, particularly when of large dimensions, and atlases; to these, the caoutchouc binding is particularly applicable, each leaf being attached with great tenacity. A large map, or chart, or even an engraving may be doubled, and bound into a book of half its size, and the fold at the back of the book, when open, be scarcely perceptible. For music books, the leaves, when bound with caoutchouc, will not fly back after the V. S. operation, as they now very frequently do to the interruption of the performer, and often to the marring of a fine passage of music. Manuscripts and collections of letters, where, in the writing of them no margin is left at the back by which they can be stitched, may be bound without the least encroachment upon the writing. And, more particularly as regards ledgers and other account books—every one having anything to do with book-keeping must have experienced the inconvenience of writing in a day book or ledger, towards the inner parts of the leaves especially, when the back, as is usually the case with such books, is of considerable thickness. The impossibility of obtaining a flat surface with ledgers, &c., bound in the ordinary way, not only retards the operation of writing, but renders it extremely tiresome, besides producing blots and stains from the difficulty of applying the pen to the paper at the proper angle; in many cases also a portion of the breadth of the sheet of paper being wasted. Mr. Hancock's patent method of binding, he states, produces such elasticity in every part of the back, that it is equally convenient and easy to write, whether the book contain fifty or five hundred leaves. That these advantages are duly appreciated, may be learned from the fact, of the approval of the invention by all the great mercantile establishments to which it has been introduced, and by the first account book makers in the trade.*

LORD WILLOUGHBY'S MACHINE FOR THE MANUFACTURE OF FUEL BY THE COMPRESSION OF PEAT.

THE expedition of steam, in its appliances by land and sea, is ever opening new ways and means to wealth; a slight scientific discovery shows how readily natural productions may be trans-

* Mechanics' Magazine, No. 745.

ported, in perfection, from one end of the earth to another, and countries clothed with additional beauty and fertility; well conducted experiments teach how to impart facility and safety to the port, or how to form the very wave, and ride it triumphantly with sail and merchandise; and other carefully calculated operations in farming demonstrate that the waste may be reclaimed with advantage, and the most useless soil be forced to contribute to the wants of man. In this latter instance, we allude to the reclamation of peat-bog in Ireland by Lord Clonbrock, confirmed and corroborated by the testimony of the several individuals who had enjoyed opportunities of trying or witnessing similar labours.

The subject is, however, more especially pressed upon our notice by the Session of the Highland Societies at Dumfries, and the various suggestions and examples for improving the country to which it tends. Among these, it has been our good fortune to be eye-witness to a very simple, but, in our opinion, immeasureably important work, which, in an earlier stage, (about a year ago), was described in our columns—we refer to the compression of peat or turf, so as to render it nearly, if not quite, equal to coal, not only for domestic consumption, but for mechanical and manufacturing purposes. We are indebted to Lord Willoughby d'Eresby for persevering through them all till he has conquered the difficulties opposed to this task, and finally and fully accomplished the object at which he aimed. In the first place, the fabrication of a machine to perform the operation was no slight obstacle, for its requisites were cheapness, ease in working, and efficiency. The two former being overcome, the latter demanded much ingenuity to discharge the moisture freely, and yet retain every particle of the combustible material. By simplifying the press, increasing its power, and wrapping the masses of peat in coarse linen, the consummation has been arrived at; and, a few days ago, we saw the wet and ragged turf, both of the surface and lower stratum, condensed in a few seconds to the hard, nearly dry, and shapely dimensions of a convenient article for firing. This sample was sent to the Highland Society; but we speak from our own observation of the process. From the first weight of 8 lbs., it was reduced to about 5½ lbs., by the discharge of 2½ lbs., of almost pure water, or 30 per cent. In bulk the reduction was nearly one-half; and, when dropped from the press, there was a firm and compact body, fit as we have said, for every economical and useful purpose.

It will be allowed that we do not over-rate the importance of this fact, when the circumstances attached to it are taken into account. First, in immense tracts of boggy country, where there is no other fuel, the very necessities of life are supplied by the common cutting of turf, and casting and drying of peat, which, after all, make but an indifferent fire. Yet it costs the

labourer and his family much toil and much time. The original preparation is little to the long journeys, week after week, and in a changeful climate, to turn and sort the peats, so as to get them dry enough to burn, a desideratum not always achieved. Now, with Lord Willoughby's invention, the cotter and his family may make plenty of excellent firing, not only for their own consumption, but for sale to neighbours otherwise employed; and this of an infinitely superior material. It surely is not imaginative to foresee, from the single piece of substance now before our eyes, the capability of immense effects. Instead of the bare and imperfect supply of the absolute want for subsistence, we have that which is better, cheaper, more easily, and more abundantly made. We have a fuel which can be applied to every agricultural and manufacturing purpose: to the burning of lime, the smelting of iron, the propagation of steam; in short, to everything which can ameliorate the condition of a population, and plant industry and activity where only idleness and wretchedness prevail. In the midst of the wild moor, the factory, with its engines and machinery, may raise its head; whilst the earth around is forced to assume the healthy forms of cultivation and productiveness. If we look at Ireland, the consequences cannot be calculated. The north of Scotland, too, offers a grand field for this improvement. In truth, it is altogether one of those happy inventions which need only to be followed up with alacrity and spirit to

"Scatter blessings o'er a smiling land."*

DURABILITY OF VARIOUS KINDS OF WOOD.

THE following are the particulars of experiments made on several kinds of wood, 1½ inch square, and 2 feet long, placed vertically in the ground, and about 1 foot 6 inches exposed to the atmosphere, on the 1st of January, 1831: examined at two different times, viz., the 8th of May, 1833, and the 24th of February, 1836:—

Species of Wood.	Remarks, 8th May, 1833.	Remarks, 24th Feb., 1836.
English Oak	Much decayed and diminished in weight	Very much decayed, especially those of open grain.
Italian Oak	Good, but decay had commenced on surface.	Do. do. rather less than the English.
Adriatic Oak	Very much decayed.	Very much decayed, excepting one piece, very good.
Leaf or Live Oak	Very good.	Three much decayed, the rest tolerable.

* Literary Gazette.

Species of Wood.	Remarks, 8th May, 1833.	Remarks, 24th Feb., 1836.
Canada White Oak	Very much decayed.	Very bad and rotten.
Memel do.	Ditto.	Ditto.
Dantzic do.	Ditto.	Exceedingly bad.
Mahogany hard	Good.	Tolerably good.
Do. soft	Much decayed.	Very bad, totally decayed.
Libanus Cedar	Good.	Tolerably good.
Pencil Cedar	Very good.	All very good, as put in the ground.
African, No. 1.	Very good.	A little decayed, and inclined to doat; better than English oak.
African, No. 2.	Very good.	Worse than No. 1.
Teak, heavy	Very good.	Rather soft, but good.
Teak, light	Good.	Soft $\frac{1}{4}$, but good.
Teak, part of Hasting's mizen-mast	Good.	Soft $\frac{1}{4}$, the rest indifferent.
Fir, Dantzic	Much decayed.	Very much decayed, rotten all through.
Fir, Riga	Much decayed.	As bad as the Dantzic.
Fir, Memel	Much decayed.	Very bad, rotten.
Fir, Red Pine	Much decayed.	Very rotten, much like the Dantzic and Riga.
Fir, Yellow Pine	Very much decayed.	Very rotten.
Do. Virginia Pine	Decayed.	Very rotten.
Do. Pitch Pine, heavy	Decayed $\frac{1}{8}$ of an inch, the rest good.	Decayed $\frac{1}{8}$ of an inch, the rest tolerably good.
Do. do. light	Very rotten.	Very rotten.
Polish Larch	Decayed $\frac{1}{4}$ in the surface, and lost in weight.	Decayed $\frac{1}{4}$, the rest a little decayed.
Scotch do. Treenails	Surface $\frac{1}{4}$ in. decayed and brittle.	Surface $\frac{1}{2}$ in. decayed, the rest brittle.
English Elm	Very rotten.	All rotten.
Canada rock do.	Ditto	Rotten.
American Ash	Ditto.	Ditto.
Locust Treenails	Good and retained their weight.	$\frac{1}{8}$ in. rotten, the rest as sound as when put in the ground.
Scotch Larch do.	Surface $\frac{1}{4}$ decayed, and very brittle.	$\frac{1}{4}$ in. rotten, the rest brittle.
Stinkwood dark col.	Surface not decayed, but very brittle.	This piece was misplaced.
Cowdie	Surface $\frac{1}{4}$ decayed, and very brittle.	Rotten.
Stinkwood light col.	Surface $\frac{1}{8}$ decayed, and brittle.	Rotten.
Poonah.	Surface a little decayed, and become light.	Surface $\frac{1}{8}$ decayed, the rest good, better than African.*

Note.—Riga preferable to all the Fir, and Dantzic next.

* Nautical Magazine; quoted in the Mechanics' Mag. No. 737.

THE BRITISH POWER-LOOM, AND HINDOO HAND-WEAVING.

The Hindoo weaver, skilful, from long practice, in the use of his simple implements, and having no competitors, did not think it necessary to tax his ingenuity, for the invention of new and improved spinning and weaving machinery, but went on, as his progenitors had done, spinning and weaving, with a wheel and loom still of the simplest construction.

The process of fabrication, by such primitive methods, is so slow, that a man and his family, in constant employment, can do little more than support themselves by their labour. When, on the contrary, the raw material is exported at heavy cost to Britain, and manufactured there, with the aid of improved machinery, it can be brought back and sold, after paying the expenses of a second voyage, from twenty to thirty per cent. under the produce of the same quality of the native loom. Owing to this difference, when the trade was thrown open, and free access was allowed to British manufactures, their cheapness soon drove the Indian ones out of their accustomed markets, and caused at first great distress to our manufacturing population. Now, however, the scales are re-adjusting themselves to our altered circumstances, and the advantages of the change are becoming evident. The exportation of piece goods, from the comparatively small quantity that could be produced for exportation, and the great expense of fabrication, never could return a proportional, if even a remunerating, profit to the country. The raw material, on the contrary, owing to the unlimited demand, the comparatively high price which it bears, and the small expense of preparing it for the market, not only remunerates, but returns such a profit, as to stimulate to a vastly increased production; when we add to this, that our growers can now clothe themselves with English cloth more cheaply than they formerly could with native, we can at once appreciate the advantages which India is in course of deriving from the English cotton manufactories; and how much her future prosperity must depend on the extension and improvement of her cotton cultivation. The fulfilling of these conditions is, in truth, indispensible to a continuance of that commercial prosperity, which is now beginning to dawn on us; since, unless we labour diligently to improve the quality, and diminish the exportation price of our cotton, great as the demand now assuredly is, we can scarcely expect that it will be able to hold its present place in the English market, when opposed by so many competitors, and, still more, by the long and expensive voyage required to bring it into that market.*

* From the Madras Journal of Literature and Science. Observations on the Flôra of Courtallum, by Robert Wight, Esq., M.D.; quoted in the Mechanics' Magazine, No. 728.

DESCRIPTION OF A PENDULUM ARTIFICIAL HORIZON, TO BE ATTACHED TO A SEXTANT OR QUADRANT FOR THE PURPOSE OF OBSERVING ALTITUDES BY DAY OR NIGHT AT SEA.

By Lieut. Becher, R.N.

A SMALL pendulum carries an arm nearly at right angles to it, springing from the point of suspension, at which the whole rests on an agate point. At the end of this arm is a vane, perpendicular to the plane of the pendulum and arm, and having its upper edge cut horizontal, which forms the visible horizon. This apparatus is placed in a tube laid in the direction of the telescope, and attached to the sextant beyond the horizon glass; the point of suspension rests on an arch within the tube, the rest of the pendulum hanging below, the vane being at the end nearest the horizon glass, its upper edge bisecting the space in the tube.

A disc is placed in the lower half of the tube, between the fixed horizon glass and the vane of the pendulum, and close to the latter without touching it; in the upper edge of the disc is a small aperture or notch A lens is placed in one end of the tube next the horizon glass, in order to show distinctly the edges of the vane and this aperture; at the other end is ground glass.

The sextant being held with its plane vertical, the reflected image is brought down to the horizontal edge of the vane, and the sextant is then oscillated in its own plane till the edge of the vane is seen exactly fair with the upper edge of the disc, or just covering the aperture. If the vane be above the aperture, this is discovered by the light appearing through two small holes in the disc. As the line of sight may not be exactly horizontal, its *error*, which is constant, is found by comparing the altitude obtained with that shown by another instrument.

The pendulum moves in a small cistern, containing oil, to diminish its vibrations; on turning up the face of the sextant to read off, the oil runs into another cistern. For observing at night, a small lamp is hung before the outer end of the tube.

On observing with the instrument in a steam vessel, the extreme error was 7′ 48″. The latitude, as found on board a small cutter in Sea reach by the altitudes of the moon and of *Jupiter*, agreed within 2′.

The error in observing is generally in excess.*

DAVENPORT AND COOK'S ELECTRO-MAGNETIC ENGINE.

IN company with Dr. Steel and several other gentlemen, we called upon Messrs. Davenport and Cook, of this village, with a view of examining the electro-magnetic engine invented by the senior partner.

* Mechanics' Magazine, No. 728.

The ingenuity, yet simplicity of its construction, the rapidity of its motion, together with the grandeur of the thought that we are witnessing the operation of machinery propelled by that subtle and all pervading principle—electricity, combine to render it the most interesting exhibition we have ever witnessed.

Although we shall say something on the subject, it is perhaps impossible to describe this machine by words alone, so as to give more than a faint idea of it to the reader.

It consists of a stationary magnetic circle, formed of disconnected segments. These segments are permanently charged magnets, the repelling poles of which are placed contiguous to each other. Within the circle stands the motive wheel, having the projecting galvanic magnets, which revolve as near the circle as they can be brought without actual contact. The galvanic magnets are charged by a battery, and when so charged, magnetic attraction and repulsion are brought into requisition in giving motion to the wheel—the poles of the galvanic magnets being changed more than a thousand times per minute.

Having in its construction but one wheel, revolving with no friction except from its own shaft, and from the wires connecting it with the galvanic battery, the latter of which can scarcely be said to impede the motion in any degree, the durability of this engine must be almost without limit.

There is no danger to be apprehended from fire or explosion; and we understand it is the opinion of scientific gentlemen who have examined it, that the expense of running this machine will not amount to one-fourth as much as that of a steam-engine of the same power.

From the time when the Greek philosopher supposed the magnet possessed a soul, its mysterious power has been regarded with increasing interest and attention to the present day. In addition to its utility in the compass, thousands have laboured in vain attempts, to obtain through its agency a rotary motion. So intense has been the application of some to this subject, that in the attempt they have even lost that elevating attribute of our species, reason. It was reserved for Mr. Davenport to succeed where so many had failed.

He commenced his labours more than three years ago, and prosecuted them under the most discouraging and unfavourable circumstances—sustained by a constitutional perseverance and a clear conviction of ultimate success. He obtained the first rotary motion in July, 1834; since which time he has devoted his whole attention to improvements in his machine. During this period it has passed through five different modifications, and is now brought to such a state of simplicity and perfection, (having apparently the fewest possible number of parts), that the proprietors consider no further important alterations desirable, except in the due proportions of the different magnets, in which they are daily improving.

We were shown a model in which the motive wheel was 5½ inches diameter, which elevated a weight of *twelve pounds.* And to illustrate the facilities for increasing the power of this engine, another model was exhibited to us with a motive wheel of eleven inches in diameter, which elevated a weight of *eighty-eight* pounds. Although these models have been for some time in progress, and we have occasionally been permitted to examine them, we have waited till the present period, when the practicability of obtaining a rapid and unlimited increase of power seems to be placed beyond a doubt, before expressing an opinion, or calling the public attention to the subject.

If this engine answers the expectations of the inventor, (and we believe no one can assign a *reason* why it should not,) it is destined to produce the greatest revolution in the commercial and mechanical interests which the world has ever witnessed. We may consider the period as commencing when machinery in general will be propelled by power concentrated upon the plan of this engine; when the vessels of all commercial nations will be guided to their point of destination and urged forward in their course by the same agent, triumphantly contending against winds and tides, with the silent sublimity of unseen but irresistible power.

The prophetic ken of science is happily exhibited by Dr. Lardner, in his treatise on the Steam Engine. His far seeing genius seems to have anticipated the invention of which we are speaking. "Philosophy," said he, "already directs her finger at sources of inexhaustible power in the phenomena of electricity and magnetism, and many causes combine to justify the expectation that we are on the eve of mechanical discoveries still greater than any which have yet appeared; and that the steam-engine itself, with the gigantic powers conferred upon it by the immortal Watt, will dwindle into insignificance in comparison with the hidden powers of nature still to be revealed, and that the day will come when that machine, which is now extending the blessing of civilization to the most remote skirts of the globe, will cease to have existence except in the page of history."*

SYMINGTON'S PATENT BOILER.

MR. SYMINGTON has lately patented a new boiler, particularly applicable to marine engines; the advantages of which are—the prevention of "priming," and that a large heating surface is obtained from one fire only. As it is well known that a more perfect combustion takes place when the fuel is collected into one burning mass, and consequently more heat given out in proportion to the quantity of fuel consumed, than when, in the usual way, it is divided into two or more smaller fires—it is cal-

* Saratoga Sentinel; quoted in the Mechanics' Magazine, No. 722.

Fig. 1.

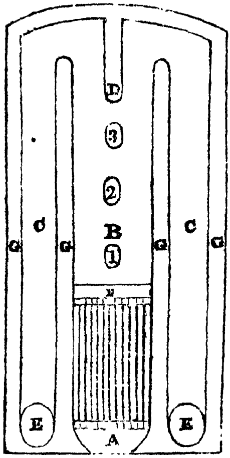
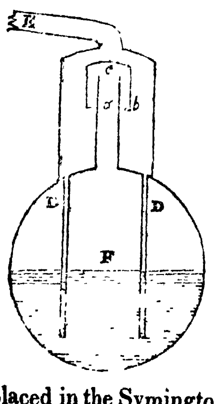


Fig. 2.



culated that a considerable saving of fuel, (the great desideratum in steam navigation), will thus be effected.

In the plan, Fig. 1, A is the furnace, B B the centre flue, which is divided into two equal divisions, by the vertical tubes 1 2 3, by means of which vertical tubes, the flame from the furnace is bisected, thereby causing it to pass in equal portions along the return flues C C, making its final exit into the chimney by the upright flues E E. G G is the interior of the boiler. The vertical tubes 1 2 3, in addition to their more immediate and direct intention, that of dividing the flame into two equal portions, and directing each portion into its respective side flue, will cause a very rapid formation of steam, as each tube contains a column of water, every part of which is exposed to a most intense heat.

Fig. 2 is a cross section of the boiler, taken through the steam chest; A A is the boiler; B B the steam chest; *a*, the steamway from the boiler to the steam-chest; *c* a cap to cover the steamway to prevent the water from the boiler being carried along the steam pipe E, into the working cylinder, which effect is technically called "priming;" D D return tubes, through which the water, that has been arrested in its progress, is returned into the boiler; F is the water level.

The description of the different parts renders any further remarks upon this portion of Mr. Symington's improvement unnecessary. Those engineers, who may have been annoyed by "priming" will at once perceive, and appreciate, the utility of the means here adopted to obviate this most vexatious evil. A boiler upon this plan has been placed in the Symington Towing Company's new tug the *Dragon*, from which very favourable results are anticipated.*

THE PINE-APPLE PLANT AND ITS FIBRE.

[We are indebted for the following account to the spirited individual who is endeavouring to call the attention of our West India proprietors to this new employment of labour and capital. This gentleman explained his views on the subject to a select party of scientific persons and others, who met at the Gallery of Practical Science, for the purpose, on June 8th.]

* Mechanics' Magazine, No. 726.

This plant, which has hitherto been valued solely as ministering to the luxuries of the table, has lately had a new interest attached to it from the discovery of a fibre contained in its leaves, possessing such valuable properties, that it will, in all probability, soon form a new and important article of commerce.

This fibre is found, on comparison, far to surpass in delicacy of texture, those materials which now form the basis of our woven manufactures: of these the principal are silk, wool, cotton, and flax. Silk is a continuous fibre, often extending, without interruption, to the length of 1,000 feet; viewed under the microscope, it is found to be perfectly cylindrical, beautifully smooth, glossy, and transparent. The best kind of prepared silk varies from 1'1,700th to 1'2,000th part of an inch in diameter. Wool, on the other hand, is a rough cylindrical fibre, which appears as if plated with irregular scales, the edges of which overlap each other; though invisible to the naked eye, its roughness may be easily detected, by drawing a fibre between the fingers, in a direction from its end to its root. It varies greatly in both length and size, the diameter of very fine wool being from 1'700th part to 1'1,200th part of an inch. Cotton, being the down of a seed-pod, has peculiar characters, a thin continuous tube, presenting the appearance of a flattened and twisted cylinder, arising, probably, from the compression which the fibre undergoes before the opening of the pod: its diameter is about the 1'1,000th part of an inch. Flax, in many respects, differs from the foregoing materials; a filament of silk, wool, or cotton, admits of no division, while, on the other hand, each filament of flax is a fasciculus or bundle of fine fibres, connected by thin membrane, and the natural gluten of the plant. These fibres may be termed ultimate, as they admit of no further subdivision: they are cylindrical tubes, disposed parallel to each other, and having the appearance of innumerable joints, their diameter varies, in different flaxes, from 1'700th to 1'2,500th part of an inch.

The fibres of the pine-apple plant are also disposed in fasciculi, each apparent fibre being an assemblage of fibres adhering together, of such exceeding delicacy, as only to measure from 1'5,000th to 1'7,000th part of an inch in diameter; viewed under the microscope, they bear considerable resemblance to silk, from their glossy, even, and smooth texture. They appear altogether destitute of joints, or other irregularities, and are remarkably transparent, particularly when viewed in water: they are very elastic, of great strength, and readily receive the most delicate dyes. This last fact appears singular, when we bear in mind the resistance, if we may be allowed the expression, which flax offers to dyes. With much trouble, and by long processes, flax will receive a few dark and dingy colours: all light and brilliant ones it wholly resists, they do not enter the fibre, but merely dry upon

it externally, and afterwards easily peel, or rub off,—in short, it may be said to be *painted*, and not *dyed*.

The preparation of the pine-fibre is exceedingly simple. If a leaf of this plant be examined, it will be found to consist of an assemblage of fibres running parallel from one extremity of the leaf to the other, embedded in the soft pabulum. All the process necessary is to pass the leaf under a "tilt hammer," the rapid action of which, in a few seconds, completely crushes it, without in the slightest degree injuring the fibre, which remains in a large skein, and then requires to be rinsed out in soft water, to cleanse it from its impurities, and be afterwards dried in the shade. So simple and so rapid is the process, that a leaf, in a quarter of an hour after being cut from the plant, may be in a state fit for the purposes of the manufacturer, as a glossy, white fibre, with its strength unimpaired by any process of maceration, which, by inducing partial putrefaction, not only materially injures the strength of flax, but also renders it of a dingy colour.

The pine-plant abounds both in our East and West Indian possessions, and may be easily propagated from the crown; the offsets from round the base of the fruit, which often amount to upwards of twenty in number; and from the young plants which spring from the parent stem; its cultivation requires but little care or expense, and the plant is of such a hardy growth, as to be almost independent of those casualties of weather, which often prove so detrimental to more delicate crops—it is one of those plants which Nature has scattered so profusely through tropical regions, whose leaves are thick and fleshy, to contain a large supply of nourishment, and covered by a thick, glazed cuticle, which admits of so little evaporation, that many of the tribe will thrive upon a barren rock, where no other plant could live. From the large portion of oxalic acid which the leaves also contain, no animal will touch them, and they are, therefore, exempt from the trespasses of cattle, &c., indeed, no greater proof of the hardiness of the plant can be given, than the fact, that in many places where lands have been under tillage, and have afterwards been abandoned, and allowed to return to a state of nature, the pine-apple plants form the only trace of former cultivation; every other cultivated plant has died away before the encroachments of the surrounding wood, while they alone have remained increasing from year to year, and have spread into large beds.

In adverting to the present state of our West Indian Colonies, we cannot but think that the discovery of this fibre will prove to them a most valuable acquisition. The small amount of labour and of capital requisite for the cultivation of the plant, its hardy growth, its abundant produce, the facility with which the fibre may be prepared from its leaves, the trifling cost at which it can be brought to market, and the value attached to it, as an article

of commerce, by those manufacturers to whom it has been submitted, seem fully to justify the opinion that it is calculated to open a new source of wealth to the colonies, and become a staple and valuable article of British manufacture.*

EFFECT OF THE WIND ON THE SPEED OF LOCOMOTIVE ENGINES ON RAILWAYS.

THE following observatious were made upon the London and Greenwich Railway, with a view to determine the effect of the wind upon an engine and train of five carriages, against a strong wind from N.N.W. crossing the line of an angle of about thirty degrees.

The Engine "Royal William."

Diameter of piston 10 inches, 16 inch stroke, wheels 5ft. diameter.

Against the wind . .	¼ mile in 40 seconds	=	22 miles per hour.
With the wind . . .	¼ mile in 36 seconds	=	25 miles per hour.
Difference	4 seconds		2 miles per hour.

Engine "The Walter."

Diameter of piston 11 in., length of stroke 18 in., wheels 5ft. diameter.

Against the wind . .	¼ mile in 34 seconds	=	26 miles per hour.
With the wind . . .	¼ mile in 32 seconds	=	28 miles per hour.
Difference	2 seconds		2 miles per hour.

It is here seen, that the difference is not so great as many persons imagine; the quantity of steam used was the same both ways, the regulator being opened as nearly as possible to the same place; the difference is less in the last instance, the engine being of greater power, and the surface exposed less than the first, being without a tender.

A ready approximate method to ascertain the velocity of a locomotive, is to count the number of revolutions of the crank or driving wheels, (if five feet diameter,) in ten seconds, the number given is the velocity in miles per hour. Thus, if making thirty revolutions, the engine or train are travelling thirty miles, and so on. If the wheels be six feet diameter, the number of revolutions in eight seconds must be taken.†

MR. BABBAGE'S CALCULATING ENGINE.

THE following "brief account of the Progress and Present State of the Calculating Engine," was published by Mr. Babbage, in a late work, the Preface of which is dated 16th April, 1837:—

"About the year, 1831, I undertook to superintend for the Government, the construction of an engine for calculating and printing mathematical and astronomical tables. Early in the

* Magazine of Popular Science, No. 18.

† Civil Engineer and Architect's Journal, No. 2.

year 1833, a small portion of the machine was put together, and it performed its work with all the precision which had been anticipated. At that period circumstances, which I could not control, caused what I then considered a temporary suspension of its progress; and the Government, on whose decision the continuance or discontinuance of the work depended, have not yet communicated to me their wishes on the question.

"Here I should willingly have left the subject; but the public having erroneously imagined, that the sums of money paid to the workmen for the construction of the engine, were the remuneration of my own services for inventing and directing its progress; and a Committee of the House of Commons having incidentally led the public to believe, that a sum of money was voted to me for that purpose, I think it right to give to that report the most direct and unequivocal contradiction."*

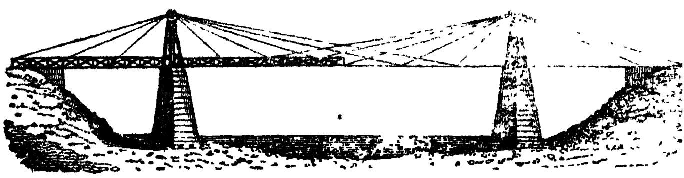
MR. BABBAGE'S NEW CALCULATING ENGINE.

"About October, 1834, I commenced the design of another and far more powerful engine. Many of the contrivances necessary for its performance, have since been discussed and drawn according to various principles; and all of them have been invented in more than one form. I consider them, even in their present state, [April, 1837,] as susceptible of practical execution, but time, thought, and expense, will probably improve them. This new engine will calculate the numerical value of any algebraical function—that, at any period previously fixed upon, or contingent on certain events, it will cease to tabulate that algebraical function, and commence the calculation of a different one, and that these changes may be repeated to any extent.

"The former engine could employ 120 figures in its calculations: the present is intended to compute with about 4,000.†

CURTIS'S INFLEXIBLE SUSPENSION BRIDGE.

The principle upon which this bridge is formed, is, that at every point of support its stability is maintained *by four forces*, viz.—the two bars radiating from the centre of each pier, and the frame of the bridge itself, which frame being connected with the



(Curtis's Inflexible Suspension Bridge.)

* Babbage. Appendix to The Ninth Bridgewater Treatise; quoted in the Magazine of Popular Science, No. 20.

† Babbage. Ninth Bridgewater Treatise; Ibid.

piers in such a way as to retain only a vertical action, allowing the bridge full liberty to accommodate itself to the changes produced upon the radial bars by their expansion and contraction ; at the same time, being confined in a horizontal direction, the inflexible frame becomes a beam, which may be resolved into two forces, acting towards and from each pier respectively, thus assisting to maintain the stability of the structure.

The result of this arrangement is, that the bridge will possess a degree of stiffness and solidity, wholly unattainable by the ordinary mode of constructing suspension bridges.

The frame of the bridge must be formed of timber, well framed together and bolted from side to side, so as to make it as stiff as possible ; upon the inside of the pier standards are fixed as vertical guides, which allow the frames to rise and fall in harmony with the contraction and expansion of the radial rods, as may be seen in the drawing.*

WIND MACHINE, APPLICABLE TO MINING PURPOSES.

By Mr. Edward Concanen.

THERE are few desiderata in mining operations of greater importance than affording effectual trial to shallow mines at the smallest possible cost, and without having recourse to the expensive machinery generally employed for that purpose. In most parts of Great Britain, the working of a mine is impeded, almost in the earliest stage of operations, by a plentiful influx of water, while the face of the country is seldom so mountainous or abrupt as to admit of relief by driving adits, except at a cost and sacrifice of time, which in most cases, far outbalance any ultimate advantage which can be derived from such a course—a truth now so generally admitted, that we are never likely again to see such long and expensive works of this kind executed, as are to be found in almost all our old mining districts.

The steam-engine, it is true, offers a most effectual resource on these occasions, but there is one great drawback in its use—the heavy expense which attends its erection—an expense, which in many cases can hardly be warranted by the precarious indications presented at a shallow depth. To avoid this heavy expenditure is evidently most desirable, as a large proportion of all mining adventures of the description we are considering, undoubtedly prove failures, and in this case the costly machinery which may have been erected can only be disposed of on terms which are highly disadvantageous to the adventurers—a truth of which we have had too many examples within the last twelvemonths.

* Civil Engineer and Architect's Journal, No. 2.

For the purpose of unwatering shallow mines without having recourse to the more expensive agency of steam, a machine of a very cheap and simple construction has been proposed by Mr. Edward Concanen, and appears from the subjoined remarks of that gentleman to have been put in execution, and fully succeeded to the extent proposed. The machine is impelled by the wind, and is in fact a horizontal windmill, with a crank attached to the upright shaft, the power being taken from this crank in any manner that may be convenient, as will be seen at a glance by referring to the sketch which accompanies this article.

In recommending this machine to public notice, as within certain limits likely to prove of some utility for mining purposes, we must not of course be understood as putting a power so unsteady and irregular in the slightest competition either with the steam-engine or the water-wheel. Considering, however, the precarious nature of the numerous minor trials which are constantly going on in all our great mining districts, we conceive it of the highest importance *to proportion the means to the end*, and to employ for operations so uncertain in their results, only the most simple and most economical machinery which may be within our reach. The efficacy of the machine in question, appears already to have been put to trial by Mr. Concanen, and to have fully answered his expectations, as will be seen by the following extracts from the communications which we have received from him on the subject.

The mode in which his attention was first drawn to the contrivance, and its subsequent application, are thus noticed :—

"Some time since, in passing through one of the most unfrequented parts of the county of Cornwall, I witnessed the effect of a piece of primitive machinery, worked by that despised and neglected power—the wind. The machine was composed of rough, deal boards roughly hung together, upon the principle of the horizontal mill—its situation, a partial eminence—its power connected to a flat rod, which descended into the valley, and was there attached to the pit-work of a shaft, which it cleared of its water—this again, on its arrival at the surface, passed over a wheel which worked some heads of stamps ; the water, however, being first received into a pool, and so husbanded as to keep a constant supply, without subjecting the wheel to irregular motion from the varied impetus of the first power. Struck with its utility, and the great scope for improvement, I returned to our own mine in the west, with a determination to make a trial of a more refined and neater constructed machine upon the same principle. The idea, a new one in that quarter, was at once condemned ; I had, however, *seen* the effect, and being liberally allowed by the gentlemen locally in power to do the best with my project, we soon completed a practicable model, which succeeded to the following effect :—Our set has not the advantage of much water ; but by the power of the wind alone, this small machine has proved herself equal to one cwt, in each revolution, the number of which vary according to the strength of the wind, from eight to twenty per minute."

"The achievement, (*without cost beyond the first outlay*), of even a

small power, is an important point gained in mining. The application in the first place enabled us materially to assist the stamp wheel by *returning* through a small lift some part of the water in continued rotation into the buckets, thus gaining a real, though artificial, supply of water in addition to that which has been so scantily afforded us from natural sources. From another small lift attached to the same machine, we draw water sufficient to supply frames for dressing the leavings, which could not otherwise have been made available during the dry winds so prevailing in the west of the county. The machine requires *no attendance*, (for this duty at least); is proof against a storm, at which time she has been known to make twenty-eight revolutions in one minute. I have had some prejudices to contend with, which have of course given way to the evidence I now produce.

"In the words of a respectable engineer, who has encouraged my views, the principle that can command a hundred weight is applicable to a ton. Convinced of this, I have pursued my improvements, and find that a machine of proper dimensions can be erected to draw moderate water at the depth of thirty fathoms from grass or under adit. The first cost is inconsiderable, and the mining cost nothing. There are some objections, of course, to the use of it, which have been obviated by the proper application of simple means; and it has still the grand claim to the notice of those interested in mining, viz., *the absence of cost.* I have sent you a plan of the power—the mill itself without connexion—both for your own inspection, and for the gratification of those who take an interest in mines. It will, of course, be understood, that competition with steam power is out of the question, but, as a cheap and generally available power in Cornwall, I think it worthy of notice, always understanding that it has been tried and has succeeded. The sixty-inch cylinder mania would have stood much in the way of its adoption some eighteen months since, even for making a small trial of a mine, but in the present state of affairs, I think it no little to be able to state that it is easy to see the bottom of a shaft thirty fathoms deep, without inconvenience to the miner, merely by the power of wind. The principal objection started is, that it will be difficult to keep the water *regularly in fork* by an uncertain power; this upon inspection of my specifications will be found to be valid. There is another purpose to which it is applicable, viz., whim-drawing; and in this instance alone, in a proper situation, is capable of saving 30*l.* per month. As I have not intruded the subject without a fair trial, I presume it to be worthy of notice beyond a bare project."

The accompanying engraving is copied from a drawing sent to us by Mr. Edward Concanen, and represents the "Wind Machine," described in his communication as having been successfully applied to mining purposes. The construction will easily be understood by reference to the explanation here given; and we may also introduce a subsequent letter, referring to the subject. A power more economical than any now in use, as we have before observed, is evidently a great desideratum in making trial of small and shallow mines: and as likely to effect this object, we are desirous of giving every publicity to this contrivance.

(Wind Machine, for Mining.)

REFERENCE TO THE DRAWING OF THE MACHINE.

AAAA—Four sails, upon which the wind is acting with full force.

BBBB—Four sails, upon the point of receiving the wind.

CCCC—Four sails, upon which the wind is acting on the back part; here there is nothing to prevent their opening, consequently the wind escapes, and in turn, as they take the situation of the quarter now facing the reader, they will close on the resisting side, and become the acting power, as AAAA.

DDD—The sails of the opposite quarter coming round, they are opening in the same rate at which BBBB are closing.

1111111—An eye in the upper corner of each frame.

22222—The line which, after passing through the hanks which are hung to the spars, enter the eye at 1, and so through on the other side, seen at AAAA, through another hank, and fastened to an iron at 3, which is sufficiently heavy to drop the sail when let go at 4.

33333—Iron slips fastened to the canvass.

4444—The plugs to which the lines are hitched while the sails are up.

5—An iron bar, which drops upon the cleet at 6, as the quarter comes round against the wind; this resists the small bar 7, which turning suddenly, throws off the line at 4, when the sails instantly drop, as is partially shown at A.

8888—The line by which the four upper lines are recovered when it is necessary to hoist up the sails.

9999—The rods that bear the rings upon which the sails run up and down.

10—The crank to which machinery is connected.

N.B.—For plain water-drawing, practical sails will not be required, but for whim-drawing, and drawing from a working shaft, it will be necessary to stop by lowering when required. For all purposes requiring proper check and regulated power, the primitive contrivance of the crank is discarded, and the rotary motion applied to cog-wheels and cylinders, upon principles already arranged.

Note.—The power of a machine upon this principle, measuring twenty-four feet from the centre of the axle to the end of the arm, placed in a proper situation, is capable of drawing a six-inch box thirty fathoms.

I have omitted to remark, in my references to the drawing of my "Wind Machine," a circumstance especially worthy of notice—viz.: it requires no adjustment to meet a change of wind, however sudden, as a proper attention to the principles of its movements will show.*

ELECTRO-MAGNETIC MOTORS.†

PROF. SILLIMAN having been invited to examine, and report upon, an Electro-magnetic Machine, invented by Mr. Thomas Davenport, of Brandon, near Rutland, Vermont, gave the subject his attention in March last, and inserted the following description in the number of his *Journal*, published in April.

The Machine was exhibited by means of a working model, in two varieties of form, viz.—

1. *The Rotary Machine, composed of revolving Electro-Magnets, with fixed permanent Magnets.*

The moving part is composed of two iron bats placed horizontally, and crossing each other at right angles. They are both five and a half inches long, and they are terminated at each end by a segment of a circle made of soft iron; these segments are each three inches long in the chord line, and their position, as they are suspended upon the ends of the iron bars, is horizontal.

This iron cross is sustained by a vertical axis, standing with its pivot in a socket, and admitting of easy rotation. The iron cross bars are wound with copper wire, covered by cotton, and they are made to form, at pleasure, a proper connexion with a small circular battery, made of concentric cylinders of copper

* Mining Review; quoted in the Railway Magazine, No. 23.

† See also page 77 of the present volume.

and zinc, which can be immersed in a quart of acidulated water. Two semicircles of strongly magnetized steel form an entire circle, interrupted only at the two opposite poles, and *within this circle, which lies horizontally,* the galvanized iron cross moves in such a manner that its iron segments revolve parallel and very near to the magnetic circle, and in the same plane. Its axis at its upper end, is fitted by a horizontal cog-wheel to another and larger vertical wheel, to whose horizontal axis weight is attached, and raised by the winding of a rope. As soon as the small battery, destined to generate the power, is properly connected with the machine, and duly excited by diluted acid, the motion begins, by the horizontal movement of the iron cross, with its circular segments or flanges. By the galvanic connexion these crosses and their connected segments are magnetized, acquiring north and south polarity at their opposite ends, and being thus subjected to the attracting and repelling force of the circular fixed magnets, a rapid horizontal movement is produced, at the rate of two to three hundred revolutions in a minute, when the small battery was used, and over six hundred with a calorimotor of large size. The rope was wound up with a weight of fourteen pounds attached, and twenty-eight pounds were lifted from the floor. The movement is instantly stopped by breaking the connexion with the battery, and then reversed by simply interchanging the connexion of the wires of the battery with those of the machine, when it becomes equally rapid in the opposite direction.

The machine, as a philosophical instrument, operates with beautiful and surprising effect, and no reason can be discovered why the motion may not be indefinitely continued. It is easy to cause a very gradual flow of the impaired or exhausted acid liquor from, and of fresh acidulated water into, the receptacle of the battery, and whenever the metal of the latter is too much corroded to be any longer efficient, another battery may be instantly substituted, and that even before the connexion of the old battery is broken. As to the energy of the power, it becomes at once a most interesting inquiry, whether it admits of indefinite increase? To this inquiry it may be replied, that provided the magnetism of both the revolving cross and of the fixed circle can be indefinitely increased, then no reason appears why the energy of the power cannot also be indefinitely increased. Now, as magnets of the common kind, usually called permanent magnets, find their limits within, at most, the power of lifting a few hundred pounds, it is obvious that the revolving galvanic magnet must, in its efficiency, be limited, by its relation to the fixed magnet. But it is an important fact, discovered by experience, that the latter is soon impaired in its power by the influence of the revolving galvanic magnet, which is easily made to surpass it in energy, and thus, as it were, to overpower it. It is obvious, therefore, that the fixed magnet, as well as the re-

volving, ought to be magnetized by galvanism, and then there is every reason to believe that the relative equality of the two, and of course their relative energy, may be permanently supported, and even carried to an extent much greater than has been hitherto attained.

2. *Rotating Machine, composed entirely of Electro-magnets both in its fixed and revolving members.*

It is the same machine that has been already described, except that the exterior fixed circle is now composed entirely of electro-magnets.

The entire apparatus is therefore constructed of soft unmagnetic iron, which, being properly wound with insulate copper-wire, is magnetized in an instant, by the power of a very small battery.

The machine is indeed the identical one used before, except that the exterior circle of permanent magnets is removed, and in its place is arranged a circle of soft iron, divided into two portions to form the poles.

These semicircles are made of hoop-iron, one inch in width, and one-eighth of an inch in thickness. They are wound with copper-wire insulated by cotton—covering about ten inches in length on each semicircle, and returning upon itself by a double winding, so as to form two layers of wire, making on both semicircles about one thousand and five hundred inches.

The iron was not wound over the entire length of one of the steel semicircles; but both ends were left projecting, and being turned inward, were made to conform to the bend of the other part; each end that is turned inward, and not wound, is about one-third of the length of the semicircle. These semicircles being thus fitted up, so as to become, at pleasure, galvanic magnetics, were placed in the same machine that has been already described, and occupied the same place that the permanent steel magnets did before. The conducting wires were so arranged, that the same current that charged the magnets of the motive wheel, charged the stationary ones placed around it, only one battery being used. It should be observed, that the stationary galvanic magnets thus substituted for the permanent steel ones, were only about half the weight of the steel magnets. This modification of the galvanic magnet, is not of course the best form for efficiency; this was used merely to try the principle, and this construction may be superseded by a different and more efficient one. But with this arrangement, and notwithstanding the imperfection of the mechanism of the machine when the battery, requiring about one quart of diluted acid to immerse it, was attached, it lifted 16 lbs. very rapidly, and when the weight was removed, it performed more than 600 revolutions per minute.

So sensible was the machine to the magnetic power, that the immersion of the battery one inch into the acidulated water was

sufficient to give it rapid motion, which attained its maximum, when the battery was entirely immersed. It appeared to me that the machine had more energy with the electro-magnets, than with those that were permanent, for with the smallest battery, whose diameter was three inches and a half—its height five inches and a half, and the *number of concentric cylinders three of copper and three of zinc*, the instrument manifested as great power as it had done with the largest batteries, and even with a large calorimotor, when it was used with a permanent instead of a galvanic magnet. With the small battery and with none but electro or galvanic magnets, it revolved with so much energy as to produce a brisk breeze, and powerfully to shake a large table on which the apparatus stood.

Although the magnetization of both the stationary and revolving magnets was imparted by one and the same battery, the magnetic power was not immediately destroyed by breaking the connexion between the battery and the stationary magnet; for, when this was done, the machine still performed its revolutions with great, although diminished energy; in practice this might be important, as it would give time to make changes in the apparatus, without stopping the movement of the machine.

Conclusions.—1. It appears, then, from the facts stated above, that electro-magnetism is quite adequate to the generation of rotary motion.

2. That it is not necessary to employ permanent magnets in any part of the construction, and that electro-magnets are far preferable, not only for the moving but for the stationary parts of the machine.

3. That the power generated by electro-magnetism may be indefinitely prolonged, since, for exhausted acids and corroded metals, fresh acids and batteries, kept always in readiness, may be substituted, even without stopping the movement.

4. That the power may be increased beyond any limit hitherto attained, and probably beyond any which can be *with certainty* assigned; since, by increasing all the members of the apparatus,—due reference being had to the relative proportionate weight, size, and form of the fixed and movable parts, to the length of the insulated wires, and the manner of winding them, and to the proper size and construction of the battery, as well as to the nature and strength of the acid or other exciting agent, and the manner of connecting the battery with the machine,—it would appear certain, that the power must be increased in some ratio which experience must ascertain.

5. As electro-magnetism has been experimentally proved to be sufficient to raise and sustain several thousands of pounds, no reason can be discovered why, when the acting surfaces are, by skilful mechanism, brought as near as possible, without contact, the continued exertion of the power should not generate a continued rotary movement, of a degree of energy inferior indeed to that exerted in actual contact, but still nearly approximating to it.

6. As the power can be generated cheaply and certainly,—as it can be continued indefinitely,—as it has been very greatly increased by very simple means,—as we have no knowledge of its limit, and may therefore presume on an indefinite augmentation of its energy, it is much to be desired, that the investigation should be prosecuted with zeal, *aided by*

correct scientific knowledge, by *mechanical skill*, and by *ample funds*. It may, therefore, be reasonably hoped, that science and art, the handmaids of discovery, will both receive from this interesting research, a liberal reward.

Science has thus, most unexpectedly, placed in our hands a new power of great but unknown energy.

It does not evoke the winds from their caverns; nor give wings to water by the urgency of heat; nor drive to exhaustion the muscular power of animals; nor operate by complicated mechanism; nor accumulate hydraulic force by damming the vexed torrents; nor summon any other form of gravitating force; but, by the simplest means—the mere contact of metallic surfaces of small extent, with feeble chemical agents, a power everywhere diffused through nature, but generally concealed from our senses, is mysteriously evolved, and by circulation in insulated wires, it is still more mysteriously augmented, a thousand and a thousand fold, until it breaks forth with incredible energy; there is no appreciable interval between its first evolution and its full maturity, and the infant starts up a giant.

Nothing since the discovery of gravitation and of the structure of the celestial systems, is so wonderful as the power evolved by galvanism; whether we contemplate it in the muscular convulsions of animals, the chemical decompositions, the solar brightness of the galvanic light, the dissipating consuming heat, and, more than all, in the magnetic energy, which leaves far behind all previous artificial accumulations of this power, and reveals, as there is full reason to believe, the grand secret of terrestrial magnetism itself.*

HOT AND COLD BLAST CAST IRON.

At the late meeting of the British Association, Mr. Fairbairne read a report on the comparative strength and other properties of cast iron, manufactured by the hot and cold blast respectively.

At a previous meeting of the Association, Mr. Hodgkinson read a report on the comparative strength and other properties of iron manufactured by the hot and cold blast.—In the prosecution of inquiries since made, it was conceived desirable to subject the metals operated upon to more than one species of strain; to vary their forms, and, by a series of changes to elicit their peculiar as well as comparative properties. First, they have been drawn asunder by direct tension. Secondly, they have been crushed by direct compression, both in short and long specimens, (the results of which will be given in a paper read subsequently); and, Thirdly, they have been subjected to fracture by transverse strain, under various forms of section, and at various temperatures. Ten bars of hot and cold blast iron were also loaded with different weights from 112lbs. to near the

* Silliman's Journal; quoted in the Magazine of Popular Science, No.19.

breaking point, and left for many months to sustain the load, and to determine the length of time necessary to effect the fracture. The bars thus loaded, are still, (with one exception), bearing the weight, having been suspended upwards of six months, and from what we can at present perceive, there is every chance of a long and protracted experiment. In making the experiment on transverse strain, a number of models of different sizes and forms were prepared, and the irons, both hot and cold blast, were run into the form of these models ; but as there is usually a slight deviation in the size of the castings from that of the model, the dimensions of the bars were accurately measured at the place of fracture, and the results reduced by calculation to what they would have been if they had been cast the exact size of the model, assuming the strength of rectangular beams to be as the breadth and the square of the depth, and the ultimate deflection to be inversely as the depth, the length being constant. In comparing two irons, the greatest care was taken to subject them as nearly as possible to the same treatment.

A series of experiments was also made to determine the strength of hot and cold blast iron at various temperatures, from 32°, (the freezing point,) to the boiling point; for this purpose a cast-iron trough was employed, in which the bars to be broken were placed and covered with snow or water, (which was kept at the proper temperature by a jet of steam,) as the case required; the weights were then gradually laid on until fracture took place.

The strength of bars made red hot was also tried, and contrary to expectation, they retained their tenacity and power to resist the load to a considerable extent; the reduction of strength in a bar one inch square, in a range of temperature from 32° to that of redness was rather more than one-sixth, the deflection being upwards of 1½ inch in a bar two feet three inches long.

Results.

Carron iron, No. 2. (Scotch.)

Mean ratio of transverse strength, assuming the cold blast iron at	1000 : 979·9
Mean ratio of power to resist impact	1000 : 1038·9

Whence in the transverse strength of Carron iron, No. 2, using a variety of forms of section, the strength of the cold blast is to that of the hot blast, as 100 to 98, nearly.

Devon iron, No. 3.

Mean ratio of strength in sections of various forms, (thirteen experiments)	1000 : 1049
Power to sustain impact	1000 : 2742

This is an exceedingly hard iron with a singular appearance, the centre or more granulated parts of the fracture being surrounded with a circle having the appearance of hardened steel.

Buffery, No. 1, Staffordshire iron, cold and hot blast.

Mean ratio of breaking weight	1000 : 925
Mean ratio of power to resist impact	1000 : 965

In the buffery iron, the hot blast manufacture is weaker whether we view it in its transverse strength, or its power to resist impact.

Coed Talon, No. 2, North Welsh iron.

Mean ratio of strength in a number of experiments......	1000 : 1014
Mean ratio of power to resist impact..................	1000 : 1219

Modulus of elasticity in lbs. for a bar of one inch square.

Cold blast { 14,680,000 / 13,947,000 } 14,313,500lbs.

Hot blast { 15,810,000 / 12,835,000 } 14,322,500lbs.

Elsecar cold blast, No. 1, against Melton hot blast, No. 1.

(Yorkshire iron.)

Mean ratio of strength................................	1000 : 809
Mean ratio of power to resist impact..................	1000 : 858

The modulus of elasticity in all the irons are computed; but only given in a few cases in the results.

Relative strength of hot and cold blast iron to resist a transverse strain at different degrees of temperature.

Cold blast 949·6 at 32°. Hot ditto 919·7, Mean.
Ratio of strength, 1,000 : 977·6.
Power to resist impact, 1,000 : 1,039.
Cold blast 748·1 at 191°. Hot ditto 823·6.

In these experiments it appeared that the cold blast lost in strength from 32° up to a blood-red perceptible in the dark, as 949·6 to 723·1; whereas in the hot blast the strength is not so much impaired, being as 917·7 at the freezing point, and 829·7 when perceptibly red in the dark.

In all former experiments on the transverse strain of cast iron it has been assumed, that the elasticity remained perfect up to one-third the breaking weight. In pursuing these experiments, discrepancies were noticed, and results widely different to those generally received were observed. It was found that one-seventh, and in some cases, one-eighth the breaking weight was sufficient to produce a permanent set. These facts induced an extended series of experiments, principally to determine what load was necessary to effect a permanent set; and, if such weight, continued for an indefinite time, would break the bar. It became a question of great importance to know, if a weight having once impaired the elasticity, would or would not, if continued, increase the deflection. The inquiry therefore, was—To what extent can cast iron be loaded without endangering its security? To solve this question ten bars of hot and cold blast, differently loaded, were placed upon a frame, to ascertain the amount of deflection at stated periods, and to determine what was necessary to break the bars with their respective loads.

	Inches.
In the cold blast, with a load of 280 lbs., the deflection increased in 103 days from........................	1·025 to 1·033
Hot blast, ditto from..................................	1·173 to 1·197
Cold blast, with a load of 336 lbs., increased in 105 days from..	1·344 to 1·366

	Inches.
Hot ditto, from	1·573 to 1·627
Cold, with a load of 392 lbs., increased the deflection in 108 days, from........	1·786 to 1·843
Hot, ditto from	1·891 to 1·966

Cold blast, with a load of 448 lbs., continued to increase in deflection and ultimately broke, after sustaining the weight 35 days. All the bars from the hot blast broke in the act of loading them with the above weight, 448lbs.

Mr. Fairbairne stated, that all the irons were made of the same materials, and under the same circumstances. The irons were of fifty sorts.

Mr. Cottam inquired as to the elastic forces. Dr. Young and Mr. Tredgold had found that the strength of the material would fail if loaded beyond its elastic force: he wished to know whether the loads had been more or less than 850 lbs. to the foot. Mr. Fairbairne stated that some of the loads were more, some less, and that a weight of 280 lbs. produced a permanent set of an inch square bar. The President remarked that the calculation as to elastic forces was scarcely to be confided in. Mr. Fairbairne in answer to another question, stated that the hot blast iron was the more flexible and better capable of bearing impact; but that all the results of impact had been taken from calculations founded on cold blast iron. Mr. Fairbairne stated that the crystalline appearance was finer in hot than in cold blast. There were no experiments made on the loss by remelting, and none on wrought iron,—all on cast iron. In reply to Mr. Cottam, he mentioned that all the Scotch irons had no cinder; the composition of the others they did not know. Great difficulty had been experienced on this point, because the different manufacturers were unwilling to give information.—Mr. Guest professed on his part the fullest readiness.—Some conversation took place with regard to the peculiarity of appearance in the broken bars. The President remarked, that when a rectangular bar of any substance is exposed either to fracture, or even to temporary deflection, a similar appearance was found: this was known from the experiments on glass by polarized light. Mr. Fairbairne in assent, said the crystals were always more compact in the edge than the centre. Mr. Webster inquired whether the elastic weight was always less than one third of the breaking weight. Mr. Fairbairne said, always—and afterwards replied to a question from Mr. Guest, that the Scotch hot blast iron showed a greater comparative strength as compared with cold blast, but that they had made no experiments on South Welsh iron. There was a perceptible permanent set from 280 lbs., the experiments being of from five to ten minutes in duration, and it being possible to judge the deflection to the 1000th part of an inch.—Mr. Webster said it had been found that the first set was owing to the breaking of the first crust, and that beyond the first

permanent set up to the elastic limit, the deflection increases exactly as the weight. Some further conversation ensued, in which Mr. Smith and others took part, when Mr. Guest suggested the propriety of further continuing these researches, to which the President agreed, and suggested a recommendation to that effect from the committee of the section to the General Committee.*

FRENCH MANUFACTURE OF INDIA-RUBBER WEB.

THE fabric of India-rubber web was commenced at Vienna, but much improved and extended in the manufactory at St. Denis, near Paris, in which there are about 1,500 of the machines for plaiting the thread around the filaments of the elastic gum, and all the other departments in correspondent proportion.

1st operation.—The gum elastic is provided in the usual form of bottles. The first operation is to divide these bottles into two equal parts; they are then placed in piles of six or eight in height, and of an indefinite number in extent, upon a plank, and another plank is placed upon them, when the two are drawn together by wooden screws and nuts. They remain in this state a sufficient time to render them flat, or to take out in a great measure the original curvature of the bottles.

2nd operation.—The first machine contains a circular knife which revolves rapidly, its diameter being about eight inches. At the side of its edge is an advancing carriage or slide, which receives its movement by means of a screw from the shaft of the knife. Upon this slide is attached the gum, a hole being made in its centre to receive a screw, which serves as a pivot upon which it may turn; it is held down by a nut that is screwed upon it, and the edges are held down by springs placed near to the knife, but not so strong as to prevent its turning under them. A box under the table contains water, in which the knife runs, and a box above it incloses the blade, and prevents the water from being thrown into the face of the workman. When the machine is started, the gum advances and is turned round by hand, whilst the knife cuts off the irregular circumference, until a continuous slip comes off, which the workman takes hold of and draws away, the carriage advancing, and the knife cutting until the gum is exhausted. The operation resembles the cutting of leather strings out of circular pieces of that material in the manner practised in the olden time by shoemakers.

3rd operation.—These slips pass into a bucket of water, from which they are taken and examined through their whole length by a woman, who removes the defective parts, and joins together the ends of the slips, by cutting them off in a sloping direction, and making a nick near the extremities, with a pair of scissors.

* Athenæum, No. 516; quoted in the Philosophical Magazine, No. 70.

These ends are then placed together, and hammered with some force upon an anvil, by which means they are made to adhere with considerable tenacity.

4th operation.—These slips thus joined pass to another engine, which resembles in almost all respects the slitting mills of iron works, of a size proportionate to the material upon which they operate. The slip, always contained in water, is guided into this cutting mill, which has five or six blades according to the width of the slip, and is kept in its place and prevented from turning by a slight spring. After passing between the cutters, it is drawn off by two rollers, between which it passes, and from thence into the hands of the attendant, who passes the slip thus divided into threads, into water.

5th operation.—The filaments then pass into the hands of females, who examine them through their whole extent, remove the imperfect parts, and join the extremities as before.

6th operation.—The next machine is important, having for its object to remove the elasticity of the gum, or in other words, to stretch the filaments to their utmost extent. It consists of a reel of eighteen or twenty inches in diameter, revolving with considerable rapidity. Between the attendant and the reel is a wheel with several grooves of different diameters, revolving with a movement slow compared to that of the reel, and which has a transverse movement from the right to the left side, thus serving as a guide to the filament, and preventing it from overlaping upon the reel. This latter wheel was evidently intended to give an equal tension to the gum, as it was wound upon the reel, but the filament was simply held by the hand, and the wheel only used as a guide; sufficient practice on the part of the workman giving to the motion every desirable regularity. The slips are left upon these reels to dry and harden for a period varying from three to six weeks.

7th operation.—They are then wound upon bobbins by the usual means of a wheel and spindle, by a woman, care being taken to retain the tension.

8th operation.—The next operation is the plaiting of silk, cotton, thread, or other material, around the filament of gum, previously coloured or white, according to the objects into which it is subsequently to be manufactured. This is performed by an extremely ingenious machine, the construction of which it would be impossible to illustrate without drawings; the machines are manufactured, and for sale in Paris, by Blanchin, No. 98, Rue Faubourg, St. Martin. They have the important quality of stopping, if a thread breaks or is exhausted.

9th operation.—The machine last alluded to, draws the filament off the bobbins upon which it was previously wound, and after plaiting around it, winds it again upon others, which when filled, are conveyed to the looms, and there placed in frames, with a strap and counter-weight to give the necessary tension, and in

sufficient number to form the warp of the web, which of course varies in width according to the object to which it is destined. The looms were usually simple and moved by hand, but there are also looms capable of weaving six webs or more at the same time, the shuttles of which are furnished with racks, by means of which they are carried through the chain.

The plaited filament is combined with silk or other matter, and filled with different materials, according to the object of the manufacturer, and in this respect, all the variety of the weaver's art may be exercised.

All the operations thus far noticed, have been performed by machinery, driven by a steam-engine, with the exception of the looms, which it appears to me are not necessarily excepted. In most of them the gum has been deprived of its elasticity, the last operation consists in restoring this quality. This is effected by taking advantage of that well-known, though extraordinary character which gum elastic possesses, of shrinking by the application of heat.

10th operation.—The machine to effect this is a long table covered with coarse cloth or felting in several thicknesses; at each end is a shaft crossing it from one side to the other, upon which are pulleys,—a strap passes over these pulleys, connecting the two ends of the table by a band, which has upon it a crotch. One of the shafts is furnished with a handle, to give motion to the whole. A heavy, square, smooth iron, heated to a convenient degree, is drawn by means of these straps from end to end; three or four webs are laid upon the table at one time, their extremities on the right are held by weights, whilst a light block lies upon them at the other extremity, keeping them flat, but not preventing their advancing as they shrink by the application of the heat of the iron; inclined planes near the ends lift off the weight at the close of the operation. The iron has wooden handles for convenient management. Baskets at one end, and boxes at the other, receive and supply the web.

The web shrinks in length as the heated iron passes over it, to about $\frac{2}{3}$ of the previous length, and has all its original elasticity restored. This operation closes the process, the web being subsequently prepared for sale by being made into rolls, and properly packed.—*Peale, Franklin Inst. Journal.**

* Quoted in the Magazine of Popular Science, No. 17.

CHEMICAL SCIENCE.

CYANIDE OF POTASSIUM, AN INCIDENTAL PRODUCT OF THE PROCESS FOR MAKING CAST-IRON IN BLAST FURNACES.

By Thomas Clark, M.D., Professor of Chemistry in Marischal College and University, Aberdeen.

During the last three years, a salt, which, when melted, is clear and colourless, but which, when solid, is of an opaque white, and generally not crystalline, has been observed to exude in the liquid state, from cracks, and other accidental outlets, around the tweers of the hot-blast furnaces for making cast-iron in the Clyde ironworks. The salt occurs in greater quantity at one time than at another; but I have not yet been able, to ascertain the circumstance in the process upon which the supply of the salt depends. The workmen say, that it occurs most after what they call a scour of the furnace, that is, after, by an excess of the fluxing ingredients of the smelting process, or an increase of the fuel, the materials accidentally adhering to the inner sides of the furnace have been dissolved away. The salt in question, however, may exude, under such circumstances, not because it is produced in greater quantity, but merely because it then finds a readier outlet at the tweer, where alone it has hitherto been observed. At the Clyde iron-works, the salt has occasionally accumulated in such quantity as to require a wheelbarrow for its removal. Upon minute inquiry I found that a similar product, although it had attracted no attention, occurred at other iron-works in Scotland, wherein, as at the Clyde iron-works, the hot blast and coal for fuel were employed; but owing to the rare use of coke in Scotland now, I am as yet, not aware whether the same product has been observed where coke is the fuel consumed.

The principal ingredient in the salt thus obtained, is *cyanide of potassium*. In a quantity that was, about a year ago submitted to an examination whereof the sequel will give an account, the cyanide of potassium made up about 53 parts in the 100, the rest being carbonate of potash, intermixed with a small quantity of carbonate of soda; but another quantity that was examined about a year previously, contained more than two thirds of cyanide of potassium. One learns, not without surprise, that so remakable a product should occur from such materials; and under such circumstances. That potassium should be there, from what source as yet I know not, will indicate that the presence of that element,

in even unpromising materials of soils for vegetation, is more general than is usually suspected. Nor will the iron-master fail, from this intimation, to warn all under his charge whom it may concern, of the perilously poisonous character of this product—a warning not idle, I presume, since on a visit to the Clyde iron-works, I learned that the workmen, having discovered its alkaline properties, some of their wives, "on household thoughts intent," had resolved to make the cyanide of potassium available in their washing-tubs. The product will, however, better merit the attention of the pharmacian, as affording a copious and cheap source whence to obtain cyanide of potassium.

The details of the investigation, having no novelty of method to boast of, might not be worth giving, were there not strong reasons for believing that, for want of due precautions, a similar product has been more than once—in the hands too of able chemists, mistaken for carbonate of potash. This induces me to give the details.

A portion of the salt, selected as free from insoluble admixture, was dissolved in water, which was done easily, and to the solution, which was distinctly alkaline, dilute nitric acid was added, until the solution, being gently heated, became neutral. Effervescence took place. The evolved gases betrayed the presence of carbonic acid by precipitating lime-water, and of hydrocyanic acid by the smell of it, which prevailed. The neutral solution gave no precipitate by nitrate of barytes, or nitrate of silver,—indicating the absence not only of sulphates and chlorides, but that of salts of several other acids, such as these reagents would precipitate. The same solution was unaffected by sulphuretted hydrogen, by sulphuret of potassium, by yellow ferro-prussiate of potash, by oxalate of ammonia, or by carbonate of potash—showing the absence of all metallic bases, except such as are alkaline.

Potassium was proved to be present, and sodium too, by crystallizing a portion of the same solution, examining the successive crops of crystals that were formed, and persevering in the crystallization until there did not remain a drop of the solution. At first the well-known crystals of nitre were obtained. Towards the end, however, when the solution had become small enough to be transfered to a watch-glass, little crystals of nitrate of soda, in their well-known rhomboidal form, appeared. This test for the presence of sodium is much more delicate than might be imagined. But another and a readier test showed the presence of sodium as decisively. A platinum wire, scrupulously clean, is by way of precaution, placed either before the tip of the inner blue flame of the blow-pipe, or so as to touch the circumference of the blue flame of alcohol. In either case, the colour of the flame is unaffected by the wire, if sufficiently clean. Dipped, however, into a strong solution of any salt containing potassium, and dried above a flame, the wire will, before the

blowpipe, show a violet flame, beyond the wire, in continuation of the blue one, but short and spread; and, in the flame of alcohol, it will tint with a like violet colour all above the wire. But a similar wire, dipped into a rather strong solution of a salt containing sodium, and treated in like manner, will give, before the blowpipe, an intense greenish-yellow light, shaped so as to seem a prolongation of the blowpipe's blue flame; and, when placed in the flame of alcohol, will embue so much of the flame as is above the wire with a similar colour. A sodium salt, although intermixed with one of potassium in a smaller proportion than 1 to 100, will give, with sufficient distinctness, a like indication of its presence. Any common gas-light, lowered till it burns blue, will answer for the detection of sodium in this manner; but to exhibit this test on the lecture-table, the flame of alcohol answers best. By this test, applied in all these modes, the salt exuded from the blast-furnaces gave distinct indications of the presence of sodium.

The proportion of nitrate of soda obtained by crystallizing the mixed nitrates of the two alkalis was manifestly small; but, as the two were evidently in a state of mixture—not of combination—it did not seem worth while to ascertain the proportions of each. Nevertheless, I made an approximative experiment, in order to form some idea of the relative proportion of the intermixed sodium salt. Equal weights of pure chloride of potassium and of mixed chlorides, formed by treating the salt under examination by pure muriatic acid, were separately precipitated by nitrate of silver, the experiment in each case being conducted in a like manner. The chloride of silver from the mixed chlorides, was to the chloride of silver from the chloride of potassium, in the proportion of not more than 1,004 to 1,000. This corresponds to about 15 of sodium salt in 1,000 of the mixture.

That the salt under examination contained no ferro-prussiate of potash, was proved by first supersaturating a watery solution of it with pure muriatic acid, and then adding a solution of a protosalt of iron. No blue appeared. That the salt did contain cyanide of potassium, was proved by first adding to a watery solution of it, a solution of protosulphate of iron, and then redissolving the precipitate by pure muriatic acid; upon which prussian blue appeared.

For want of attending to the order in which these reagents should be used, an eminent chemist, expressly seeking for the production of an alkaline cyanide, has merely proved the absence of a ferro-prussiate, where he conceives he proved the absence of an alkaline cyanide.—(*Ann. de Chim. et de Phys.* tom. lix. pp. 268, 269.)

To ascertain the proportion of cyanide of potassium, the method was adopted—which repeated experience has taught me to regard as the best—of estimating that cyanide from what peroxide of mercury it can render soluble. All the precaution re-

quired is, that the peroxide be pure and in fine powder. Accordingly, 12 grains of the salt were dissolved in about 1,000 grains of water, and treated with peroxide. Were those 12 grains entirely cyanide of potassium, they would dissolve 20 grains of the peroxide of mercury. In point of fact, they dissolved, in three experiments, as under:

10·77 grains, corresponding to cyanide of potassium	53·9 in 100
10·77 ———	53·8
10·5 ———	52·5
Cyanide of potassium	53·4 in 100

Having found, by preliminary experiments, that a given weight of carbonate of potash precipitated from a solution of chloride of calcium, the same weight of carbonate of lime, whether pure cyanide of potassium was added to it or not, I resolved to estimate the carbonate of potash by that method. 50 grains of the salt gave, of carbonate of lime, in two experiments:

16·5 grains, corresponding to carbonate of potash	45·3 in 100
16·9 ———	46·3
Carbonate of potash........	45·8 in 100

Together, the result is, for 100 parts,

Cyanide of potassium	53·4
Carbonate of potash	45·8
	99·2
Loss	·8

—a result confirmatory of sodium being present in small quantity.

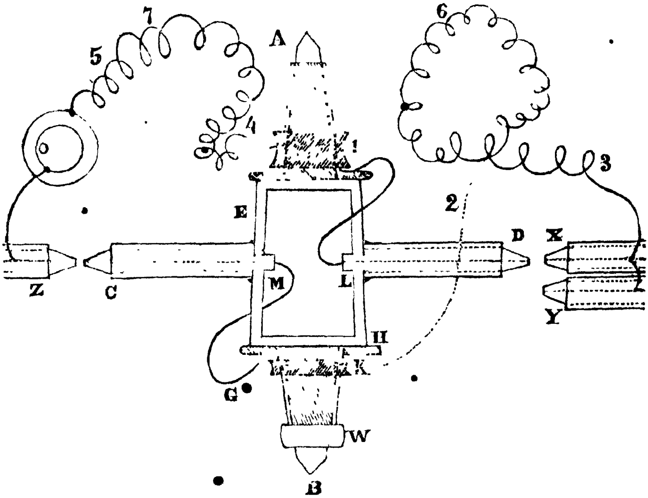
That the salt contained no caustic alkali was thus proved. Into a weak solution of the salt, a solution of nitrate of silver, likewise weak, was dropped. The precipitate was white, as would occur from a solution either of cyanide of potassium or of carbonate of potash. Into a similar solution of the salt, one or two drops of a weak solution of caustic potash were let fall, and, afterwards, one drop of the nitrate of silver solution; whereupon the light grayish brown, indicative of the precipitation of oxide of silver, at once appeared. The absence of this light grayish brown in the previous experiment, demonstrated the absence of caustic potash or caustic soda in the salt under examination.*

* In reference to the subject of Dr. Clark's paper, we may cite a notice in Phil. Mag., First Series, vol. lxii. p. 234.—Quoted in the Philosophical Magazine, Third Series, No. 62.

THE TWO ELECTRICITIES—VELOCITY OF ELECTRIC LIGHT.

At the late meeting of the British Association, Mr. Ettrick read a paper on the Two Electricities, and on Professor Wheatstone's Determination of the Velocity of Electric Light. He stated that he had read a paper before the Society in the previous year, showing, that in piercing a card by the electric discharge, two or more holes are invariably made; and he contended, that they indicated the passage of two or more electric fluids, rather than two or more successive discharges. He then said, that such opinion had been confirmed by an observation made this year on the spontaneous discharge of the Leyden jar, in which he had observed that the lines or marks made upon the glass of the uncoated part of the jar, are not single, as they appear to a superficial observer, but double: the two zigzag lines going parallel to each other, however numerous the bends or turns may be, with one exception, where they cross each other on the outside. Though some parts of these lines appear as straight or regularly curved lines; nevertheless, they are not so, but consist of an infinite number of minute sharp bends, which, by going in the same direction nearly, give it the appearance of a straight line. Whatever objections might have been made to the supposition of these two lines representing the passage of two distinct electricities, before the discovery of the crossing of the lines, after such a remark, Mr. Ettrick contended, we have an ocular demonstration of it. He then stated, that he had repeatedly observed an appearance in the spark from coated surfaces, that indicated the passage of contrary electricities, not only when the discharge was made in an exhausted receiver, but also in common air. The spark appeared as if divided into two portions by three blueish bands of light, one at each end, and another in the middle, which could not be supposed to be the case by the passage of the electric fluid from one end only. He then showed, that the old remark respecting the brush of light upon positively electrified points, and the star on negative ones, could not be taken as any proof of the passage of the electricity in one direction only; because the appearances are greatly modified by circumstances. If the point be placed in a glass tube, drawn out to a fine point, then the only perceptible difference is in the length of the brush, the positive being twice the length of the negative brush. He said that, although experiments similar to these tended to show the passage of two electricities, nevertheless, they cannot be taken as absolute proofs, which, he contended, could only be directly proved by the visible passage of the two electricities, which Professor Wheatstone had shown a means of accomplishing. Mr. Ettrick then said, that it was much to be regretted that Prof. Wheatstone did not succeed in his first attempt to ascertain the velocity, but was obliged to resort to the secondary method by reflection. He then described a

machine, by which he had rendered the passage of the electric light visible without reflection. To convey to our readers some idea of this instrument in its action, we give a cut representing the material parts of it.



Let A B represent the two points of an iron frame, moving in a solid cast metal stand. The central part of this frame is made square, as at E G F H, and at the sides the hollow brass tubes C D are fixed, having the hollow insulating glass rods C M, D L, through which the copper wires C M G, D L F pass, and touch the pieces of brass K I, insulated by glass cones with flanges. At Z X and Y there are brass tubes, having glass tubes, through which copper wires pass.

The action of the machine was stated to be as follows:—Suppose the inner one of the two circles to represent the inside coating of a Leyden jar, and the outer circle the outside coating. If an electric discharge be supposed to pass along the wire O to Z, and leap the interruption from Z to C, it would then pass on through the wire C M G to K, then through the wire 2 to the coil of wire 2 6 3, which was said to be one mile and a half long, when it passed on to X, from thence to D L F I, where crossing the brass, it entered the coil 4 7 5, and went to the outside of the jar. This supposes the machine to be stationary, but if it be now supposed to be put in rapid motion, the point D moving from X to Y, and that the point C is opposite the point Z, the point D being also opposite the point X, at the moment the electric fluid enters the coil at 2: then before it can pass through the coil 2 6 3, the point D will have passed the point X, and if the distance X Y be not too much, the electricity will strike the point Y, which is also connected with the coil of wire 2 6 3. Therefore, knowing the length of the coil, the diameter of the circle, through which the points pass, the velocity of the machine, and the distance of the points, we can easily ascertain the velocity of the electric light. Mr.

Ettrick stated, that in a rough trial of it, the velocity was found to exceed 118,000 miles in a second of time, for it struck the point Y, when the velocity of the machine was eighty times in a second, the arms eighteen inches long, and the distance of the points one-tenth of an inch.*

EXPERIMENT ON THE INTERFERENCE OF LIGHT.

By H. F. Talbot, Esq., F. R. S.

I BELIEVE the following experiment to be a new one, and it seems to afford a satisfactory illustration of the theory.

Make a circular hole in a piece of card of the size of the pupil of the eye. Cover one half of this opening with an extremely thin film of glass (probably mica would answer the purpose as well, or better). Then view through this aperture a perfect spectrum formed by a prism of moderate dispersive power, and the spectrum will appear covered throughout its length with parallel obscure bands, resembling the absorptions produced by iodine vapour.

The cause of this phenomenon probably is, that one half of the light which passes through the glass film has its undulations thereby retarded by a certain quantity, which may be called A.

Let L be the length of the undulation of any coloured ray, which I suppose to be a much smaller quantity than A.

Then if we consider the colours in succession, L increases progressively from the violet to the red. Consequently the quotient $\frac{A}{L}$ becomes by turns a whole number and a fraction, and then again a whole number, and so on alternately a great number of times. Whenever $\frac{A}{L}$ is a whole number, the two halves of the light agree in the phase of their undulation. But when $\frac{A}{L}$ is midway between two whole numbers, the two portions of light are opposed in phase, and therefore the corresponding colour cannot make its appearance in the spectrum at all; and therefore also a dark band appears in the place it would have occupied.†

ELECTRIC CURRENTS.

ON February 2, were read before the Royal Society, Observations on the Electro-chemical Influence of long-continued Electric Currents of Low Tension; by Golding Bird, Esq., F. L. S., F. G. S., Lecturer on Experimental Philosophy at Guy's Hospital. Communicated by Thomas Bell, Esq., F. R. S.

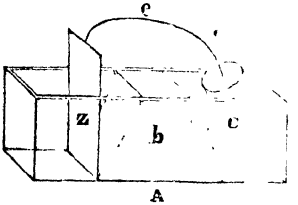
* Mechanics' Magazine, No. 744.
† Philosophical Magazine, No. 62.

The author, after observing that the brilliant discoveries in electro-chemistry obtained by Sir Humphry Davy were effected by the employment of voltaic currents of high intensity, elicited by means of large batteries, adverts to the labours of M. Becquerel, to whom we are indebted for the knowledge of the chemical agency of feeble currents in reducing several refractory oxides to the metallic state: and also to those of Dr. E. Davy, Bucholz, and Professor Faraday, in effecting decompositions of other substances by similar means. In prosecuting this branch of inquiry, the author employed an apparatus analogous to that of Professor Daniell, for obtaining an equal and continuous current of low intensity from a single pair of plates: the metallic solution, in which a copper-plate was immersed, being contained in a glass tube, closed at the bottom by a diaphragm of plaster of Paris, and itself plunged in a weak solution of brine contained in a larger vessel, in which a plate of zinc was immersed; and a communication being established between the two metallic plates by connecting wires. By the feeble, but continuous current thus elicited, sulphate of copper is found to be slowly decomposed, affording beautiful crystals of metallic copper. Iron, tin, zinc, bismuth, antimony, lead and silver, may, in like manner, be reduced, by a similar and slightly modified process; in general appearing with metallic lustre, and in a crystalline form, and presenting a remarkable contrast in their appearance to the irregular, soft, and spongy masses obtained from the same solutions by means of large batteries. The crystals of copper rival in hardness and malleability the finest specimens of native copper, which they much resemble in appearance. The crystallization of bismuth, lead, and silver, by this process, is very beautiful; that of bismuth being lamellar, of a lustre approaching to that of iron, but with the reddish tint peculiar to the former metal. Silver may thus be procured of the whiteness of snow, and usually in the form of needles. Some metals, such as nickel, which, when acted on by currents from large batteries, are deposited from their solutions as oxides only, are obtained by means of the apparatus used by the author, in a brilliant metallic form. He further found that he could in this way reduce even the more refractory metallic oxides, such as silica, which resist the action of powerful batteries, and which M. Becquerel could only obtain in alloy with iron. By a slight modification of the apparatus, he was enabled to form amalgams both of potassium and of sodium with mercury, by the decomposition of solutions of chlorides of those bases; and in like manner ammonium was easily reduced, when in contact with mercury, by the influence of a feeble voltaic current. In this last experiment it was found that an interruption to the continuance of the current, even for a few seconds, is sufficient to destroy the whole of the product, which had been the result of the previous long-continued action; the spongy am-

moniacal amalgam being instantly decomposed, and the ammonia formed being dissolved in the surrounding fluid.*

EXPERIMENTS ON THE INFLUENCE OF VOLTAIC ELECTRICITY ON COPPER PYRITES.

By R. Wear Fox, Esq.†



In the annexed wood-cut, *a* may represent a trough of wood or earthenware: *b*, a mass or wall of moistened clay firmly pressed down, and dividing the trough into two water-tight cells or compartments; *c*, a piece of the native yellow or bisulphuret of copper in a solution of sulphate of copper; *z*, a zinc plate in water,‡ and connected with the copper ore *c*, by means of the copper wire *e*.

In a very short time the yellow copper ore became beautifully iridescent, resembling the "peacock" copper ore of the miners. It afterwards seemed to pass into the purple ore (Buntkupfererz), and ultimately into the grey copper ore. This change was not merely superficial, but penetrated to some little depth under the surface when left in action for some time, perhaps two or three weeks. Metallic copper in brilliant crystals (mostly octohedrons), was deposited on the ore, care having been taken to throw into the cell pieces of sulphate of copper from time to time, as it seemed to be required. It appears that one portion of the sulphur becomes combined with the oxygen of the oxide of copper in solution, forming sulphuric acid, which passes through the clay and combines with the zinc. I have also substituted for the zinc a piece of grey copper ore, and found that grey and yellow copper ore acted upon each other with sufficient energy to change the surface of the latter into grey copper ore, and to deposit some metallic copper upon it. When these ores (the grey and the yellow sulphuret of copper) are separated merely by clay, moistened with water taken from a mine, a galvanometer will show that there is a decided voltaic action between them. These experiments owe their chief interest to the circumstance of their bearing on some phenomena which our copper

* Philosophical Magazine, No. 62.

† The experiment here described is that which excited such intense interest at the Bristol meeting of the British Association. The above description has been politely communicated by Mr. Fox.

‡ I at first used a little sulphuric acid with the water, but the latter only will answer well.

veins present; such, for instance, as the occurrence of metallic copper frequently in contact with grey or black ore, and not with yellow copper ore; and also of grey ore being usually found nearer the surface than yellow; and likewise in or near cross-courses and situations in which it may have been most exposed to the action of water, and the saline matter which it may have contained.

I have likewise found that when the muriate of tin is submitted to voltaic action, a portion of it is collected in the state of a peroxide at the positive pole; whilst another portion appears in a metallic state at the negative pole. This experiment appears to explain why we find tin and copper ore generally so distinct from each other, in opposite parts of the same vein, or in different veins, and very often one of these metals is found in a vein whilst traversing granite, and the other whilst it traverses "killas."*

BROWNING GUN-BARRELS.

At the late meeting of the British Association, Mr. Ettrick submitted a paper on browning gun-barrels. After various experiments, Mr. Ettrick discovered that the process consisted wholly in procuring a permanent peroxide of iron, and then colouring such oxide. He had procured not only all shades of brown, but a perfect black, by mixing one part of nitric acid with 100 parts of water, and applying this to the barrel with a rag moistened with it. It is material that the rag should be only so much wetted as to damp the iron, for if the fluid be allowed to stream, the oxidation will be unequally performed. It is also material that the barrel should be well smoothed and polished, and all greasiness removed by chalk before the browning commences, otherwise a bright brown is not attainable. The barrel, after being wet, should be placed for an hour or more in a window on which the sun shines, and when this process has been thrice repeated, the superfluous rust must be removed by a scratch brush consisting of a quantity of fine iron wire, tied up into a bundle. This process being repeated eight or ten times, the barrel will have acquired as good a brown as it frequently receives from the common gunsmiths; but to do away with the disagreeable, rusty appearance, it is necessary to proceed to colour the oxide, which Mr. Ettrick accomplishes by dissolving 1 grain of nitrate of silver in 500 of water, and applying this solution, like the browning liquid. The number of repetitions of the nitrate of silver water would depend on the shade of brown required, but Mr. Ettrick found from 1 to 5 or 6 amply sufficient. The barrel is to be placed in the sunshine to obtain a dark colour. The last process was to apply the scratch brush freely, though lightly, and then

* Sturgeon's Annals of Electricity, No. 2.

polish the whole with bees' wax. Mr. Ettrick had, since the date of his own invention, discovered the process used by workmen generally, and long kept secret, but by the plan described, a much finer brown is attainable than that gained by the trade.*

THE THERMO-ELECTRIC SPARK.

By C. Wheatstone, Esq., F. R. S., Professor of Experimental Philosophy in King's College, London.

THE following notice of some recent experiments made in Italy, on the production of the thermo-electric spark, and on the chemical effects of the thermo-electric currents, will, no doubt, be acceptable. I shall confine myself to a simple statement and corroboration of the facts, avoiding all theoretical considerations.

The Cav. Antinori, Director of the Museum at Florence, having heard that Prof. Linari, of the University of Siena, had succeeded in obtaining the electric spark from the torpedo by means of an electro-dynamic helix and a temporary magnet, conceived that a spark might be obtained by applying the same means to the thermo-electric pile. Appealing to experiment, his anticipations were fully realized. No account of the original investigations of Antinori has reached this country, but Prof. Linari, to whom he early communicated the results he had obtained, immediately repeated them, and published the following additional observations of his own, in *L'Indicatore Sanese*, No. 50, of Dec. 13, 1836.

"1. With an apparatus consisting of temporary magnets and electro-dynamic spirals, the wire of which was 505 feet in length, he obtained a brilliant spark from a thermo-electric pile of Nobili's construction, consisting only of 25 elements, which was also observed in open daylight.

"2. With a wire 8 feet long coiled into a simple helix, the spark constantly appeared in the dark, on breaking contact, at every interruption of the current; with a wire 15 inches long he saw it seldom, but distinctly; and with a double pile, even when the wire was only 8 inches long. In all the above-mentioned cases the spark was observed only on breaking contact, however much the length of the wire was diminished.

"3. The pile consisting merely of these few elements, and within such restricted limits of temperature as those of ice and boiling water, readily decomposed water. Short wires were employed having oxidizable extremities; the hydrogen was sensibly evolved at one of the poles.

"4. A mixture of marine salt moistened with water and of nitrate of silver, being placed between two small horizontal plates of gold, communicating respectively with the wires of the pile, the latter after having acted on the mixture, gave evident signs of the appearance of revivified silver on the plate which was next the antimony.

"5. An unmagnetic needle placed within a close helix formed by the wire of the circuit became well magnetized by the current.

"6. Under the action of the same current the phenomenon of the palpitation of mercury was distinctly observed."

* Mechanics' Magazine, No. 744.

The interesting nature of these experiments induced me to attempt to verify the principal result. The thermo-electric pile I employed consisted of 33 elements of bismuth and antimony formed into a cylindrical bundle ¾ of an inch in diameter and 1 1-5 inch in length; the poles of this pile were connected by means of two thick wires, with a spiral of copper ribbon 50 feet in length and 1¼ inch broad, the coils being well insulated by brown paper and silk. One face of the pile was heated by means of a red-hot iron brought within a short distance of it, and the other face was kept cool by contact with ice. Two stout wires formed the communication between the poles of the pile and the spiral, and the contact was broken, when required, in a mercury cup between one extremity of the spiral and one of these wires. Whenever contact was thus broken, a small but distinct spark was seen, which was visible even in daylight. Professors Daniell, Henry, and Bache assisted in the experiment, and were all equally satisfied of the reality of the appearance.

At another trial the spark was obtained from the same spiral connected with a small pile of 50 elements, on which occasion Dr. Faraday and Prof. Johnston were present, and verified the fact. On connecting two such piles together, so that the similar poles of each were connected with the same wires, the same was seen still brighter.*

I conclude, therefore, that the experiment of Antinori is a real addition to our knowledge of electrical phenomena, and though it was far from being unexpected, it supplies a link that was wanting in the chain of the experimental evidence which tends to prove that electricity, from sources however varied, is similar in its nature and effects, a conclusion rendered more than probable by the recent discoveries of Faraday. The effects thus obtained from the electric current originating in the thermo-electric pile may, no doubt, be easily exalted by those who have the requisite apparatus at their disposal. It is not too much to expect, seeing the effects produced by a pile of such small dimensions, that by proper combinations, the effects may be exalted to equal those of an ordinary voltaic pile.

I shall close this hasty communication with a notice of some experiments on the chemical action of the thermo-electric pile made earlier by Prof. G. D. Botto, of the University of Turin. The form of the pile he employed may suggest some useful hints to those who are inclined to continue the inquiry, as it admits of the application of much higher degrees of heat than one of the ordinary construction does, though the difference of the thermo-electric relations of the two metals employed is not so considerable. Prof. Botto's experiments were published in the *Bibliothèque Universelle* for September, 1832, and I am not

* The two piles here employed were made by Mr. Newman, of Regent Street.

aware that they have yet been published in any English Journal. The thermo-electric apparatus was a metallic wire, or chain, consisting of 120 pieces of platinum wire, each one inch in length and 1·100th of an inch in diameter, alternating with the same number of pieces of soft iron wire of the same dimensions. This wire was coiled as a helix round a wooden rule 18 inches long, in such a manner that the joints were placed alternately at each side of the rule, being removed from the wood at one side to the distance of four lines. Employing a spirit-lamp of the same length as the helix, and one of Nobili's galvanometers, a very energetic current was shown to exist; acidulated water was decomposed, and the decomposition was much more abundant when copper instead of platinum poles were used: in this case hydrogen only was liberated. The current and decomposition were augmented when the joints were heated more highly. Better effects were obtained with a pile of bismuth and antimony, consisting of 140 elements bound together into a parallelopiped, having for its base a square of two inches, three lines, and an nch in height.*

ÆTHEREAL OIL OF WINE.

It is well known that a mixture of alcohol and water in the same proportions as they exist in wine has scarcely any odour, whilst a few drops of wine remaining in a bottle will be easily recognised by its smell. This characteristic odour, which is possessed by all wines in a greater or less degree, is produced by a peculiar substance, which has all the characters of an essential oil. This substance is not to be confounded with the aroma of wine; for it is not volatile, and appears to be different in various kinds of wine, and in the greater number it does not exist at all.

When large quantities of wine are submitted to distillation, an oily substance is obtained towards the end of the operation; it is also procured from wine lees, and especially from that which is deposited in the casks after fermentation has commenced.

This æthereal oil forms about one 40,000dth part of wine. In its original state it has a strong flavour, is usually colourless, but owing to the presence of a small portion of oxide of copper, it is sometimes greenish: when this is separated by hydrosulphuric acid it is colourless. The mode of purifying this substance will be mentioned after its composition and principal properties have been described.

This æthereal oil of wine contains a considerable quantity of oxygen; but its constitution is very different from that of the oxygenated essential oils hitherto known. It consists of a new peculiar acid, analagous to the fatty acids, combined with æther; and it of course is one of the class of compound æthers. It is

* Philosophical Magazine, No. 62.

the first instance of the occurrence of an æther which is insoluble in water, and produced during the vinous fermentation without the intervention of the chemist. The strong resemblance which this substance bears to the essential oils, ought to cause them to be studied under the same point of view, and it is probable that light may be thrown thereby upon this class of organic compounds. To the new acid MM. Liebig and Pelouse have given the name of *œnanthic acid*, and to the essential oil *œnanthic æther.**

PREPARATION OF BORON.

In the process for obtaining boron by the action of potassium on boracic acid, a considerable loss has been generally experienced in consequence of an explosion which usually accompanies the combination. A more economical method has therefore been proposed, viz. to decompose an alkaline fluoborate by potassium. It appears to me that there can be only two causes which can produce the explosion in the first mode of preparation—either the presence of water in the boracic acid (as suggested by Dr. Thomson of Glasgow), or the existence of this fluid either in the potassium itself, or in connexion with the same metal. I believe (says Dr. R. D. T.) the latter circumstance to be the cause of the failure of the experiment in most cases. I have succeeded (he continues) in forming pure boron readily by the following plan:—A portion of Tuscan boracic acid was fused in a red heat, in a platinum crucible, till it became perfectly white; it was then taken out of the crucible and reduced to a granular powder; two parts of potassium were then introduced into a common test-tube. Care should be taken to remove the white crust which usually covers potassium, as it occurs in the country; this coating is hydrate of potash, generated by the action of water contained in English naphtha. If German naphtha is employed to preserve the potassium, there is little or no hydrate of potash formed. The quantity of water in English naphtha is sometimes so considerable, that I have actually seen potassium take fire when introduced into it. For the specimen of potassium with which the present experiments were made, I am indebted to the kindness of Mr. Graham, of Glasgow. To proceed with the process: the potassium, cut into minute fragments, was mixed with one part of the granular boracic acid described; the tube was then cautiously exposed to the flame of a spirit lamp; scanty white fumes began to be discharged; as soon as they ceased to be formed, the mixture was heated to redness, and the process continued for ten minutes; when the tube had cooled, a drop of water was introduced in contact with this mixture by means of a glass rod; no action occurred, showing that no potassium was present; a quantity of water was then introduced into the tube,

* Philosophical Magazine, No. 62.

mixed with some muriatic acid; the tube was washed out, and the contents thrown upon a filter; the boron was well washed and dried; it possessed a fine, deep, brown colour, and was entirely converted into boracic acid by ignition with nitrate of potash.

The improvements, therefore, in the process for preparing boron now described, consist, 1st, in pointing out the probable cause of former failures, viz. the employment of potassium containing water; and 2nd, the use of boracic acid in a granular or rough state, which enables the decomposition to go on slowly, and thus prevents the rapid union of elements either foreign or essential to the process. We are thus enabled to witness the whole operation; no violent action occurring to prevent the performance of the experiment in a glass tube.—*British Annals of Medicine, Feb.* 1837.*

EXPERIMENTS ON CAMPHOR.

MM. Dumas and Peligot have made the following statements as the results of their experiments on common camphor: Neutral and oxygenated organic bodies, when their vapour contains half a volume of oxygen, approximate alcohol in general in the nature of their reactions. This is at any rate what happens with the spirit of wood, oil of potatoes, ethal, and pyroacetic spirit. This generalization struck us long since, and we have subjected common camphor, which is so constituted, to the action of some bodies which would allow of procuring from them decisive products, admitting that campkor would act like alcohol. We shall limit ourselves to stating here, that common camphor, treated with anhydrous phosphoric acid, furnishes a liquid volatile oily carburetted hydrogen composed of C^{40} H^{28}; this then comes from the camphor, as if this body, being formed of C^{40} H^{28}, H^4 O^2, should lose its water under the influence of the phosphoric acid. On acting upon camphor by sulphuric acid, a light volatile oil is also obtained. It appeared to us to be formed of the carburetted hydrogen preceding and camphor, in variable proportions. By rectification with anhydrous phosphoric acid, it resolves always into the carburetted hydrogen C^{40} H^{28} already mentioned.†

REMARKS ON THE ORIGIN OF AMBER.

By H. R. Göppert.‡

While, during the month of April of this year, I was engaged in the examination of the deposit of brown coal at Muskau, I discovered, besides a rhizomorpha and a lichen allied to the

* Quoted in the Philosophical Magazine, No. 62.

† Ibid.

‡ From Poggendorff's Analen der Physik und Chemie, 1836.

Pyrenula nitida, (the only representatives of this family at present known in the flora of the ancient world,) a large quantity of amber, which occurs in fossil wood apparently coniferous, partly in large disseminated portions, and partly in the resin vessels themselves. A fir cone, found there by Mr. Kehlosen, director of the alum manufactory, approaches most nearly the cone of the Pinus Sylvestris, but differs exceedingly from some others which were obtained at Salyhausen in the Wetterau, and which have been kindly placed at my disposal by Mr. Keferstein. These belong evidently to the genus Abies, and still contain, between and on the scales, a large quantity of amber, and may therefore with much greater reason be regarded as the cones of the amber-tree, than the cones found included in amber. Specimens of the latter description are extremely rare, but Dr. Behrendt of Dantzic, and Professor Reich of Berlin, each possesses one, and both are very nearly allied to the genus Larix, as was formerly remarked of the last specimen by Professer Link, (*Handbuch der physikalischen Erdbeschreibung*, vol. ii. part 1, p. 333); both belong to the same species, and only differ in size. Besides alluding to these vegetable productions yielding amber, all of which have been found in the brown coal formation, I have to mention an observation which is probably new, and which has been communicated to me by Dr. Schneider of Bunzlaw, viz. that amber occurs in coniferous plants associated with ferns in the coal of Wenig-Rackvity, a deposit that has been referred by Raumer to the quader-sandstone. Since then it appears that we already know four different species of tree which afford amber, (and the number would doubtless be increased by attentive investigation,) the probability seems to me to be rendered still stronger, *that amber is nothing else than an indurated resin derived from various trees of the family of the Coniferæ; which resin is found in a like condition in all zones, because its usual original depositories, viz. beds of brown coal, have been formed almost every where under similar circumstances.**

ON THE BURNING OF LIMESTONE, OR THE DECOMPOSITION OF CARBONATE OF LIME BY HEAT.

M. Gay-Lussac observes, that it has long been supposed that the calcination of limestone is accelerated by the presence of water; and the opinion appears to be adopted by lime-burners in general. M. Dumas admits the influence of water to be unquestionable, and he gives two explanations of its action; either, says he, it acts upon the carbonate, and forms a temporary hydrate, taking the place of the carbonic acid for a very short time, for the hydrate of lime itself is decomposed by a red

* Jameson's Journal, No. 45.

heat; or the water being decomposed by the carbon, employed as a combustible, is converted into various gases, of which carburetted hydrogen forms a part, and this re-acting upon the carbonic acid of the carbonate, tends to convert it into oxide of carbon, and thus facilitates the separation from the carbonate of lime. Thus, limestone fresh quarried, and consequently still moist, ought to be more readily calcined than the stone which is nearly dry; and most lime-burners are well acquainted with this fact, and sprinkle with water the limestone which has been long procured before they charge the kilns with it."* The first of these explanations is, however, inadmissible, for hydrate of lime is decomposed at a temperature lower than that at which carbonate of lime is decomposed under the influence of water. On considering the circumstances of the combustion in lime-kilns, the second explanation does not appear to M. Gay-Lussac to be applicable, and he therefore proceeds to some observations which he thinks will explain the influence of the water. A porcelain tube was filled with bits of marble and placed in a furnace, the heat of which was easily regulated; a glass retort containing water was adapted to one end of the tube, and at the other a glass tube to receive the carbonic acid gas. The heat was raised sufficiently high to decompose the marble, and on shutting the ash-pit door the heat fell to a dull red, and the carbonic acid ceased to come over; and at this instant the water was boiled in the retort, and carbonic acid was abundantly obtained. On discontinuing the vapour, the disengagement of acid instantly ceased, and returned only on continuing the vapour. It appears, therefore, proved that the vapour of water actually favours the decomposition of the carbonate of lime by heat, and that by its operation this decomposition may occur at a lower temperature than is otherwise requisite. M. Gay-Lussac considers the action of the water to be entirely mechanical. When the carbonate of lime is exposed to heat, and is near the point of decomposition, an atmosphere of carbonic acid is formed around it, which presses upon the acid remaining combined, so that the latter, that it may be disengaged, must overcome the pressure of this atmosphere. This, however, cannot occur without still further raising the temperature, or removing the carbonic acid and forming a vacuum, or by displacing it, either by the vapour of water, or some other elastic fluid, such as atmospheric air. This explanation is supported by the following experiment:—Carbonate of lime was heated in a porcelain tube nearly to its decomposing point, and then a current of atmospheric air was passed over it. The disengagement of carbonic acid immediately commenced, continued with the current air, ceased when it was stopped, and recommenced with it. M. Gay-Lussac, therefore, considers it as proved, that the

* Dumas, *Traité de Chimie*, ii. p. 482.

influence of aqueous vapour, in the calcination of limestone, is confined to the production of a vacuum for carbonic acid, and to the prevention of the pressure of the disengaged acid, upon that which remains with the lime. When the vapour is present, a lower temperature is requird to dislodge the carbonic acid; but the importance of this influence must not be overrated. The water, in calcareous stones, is mechanically interposed between their particles; and, with the exception of some minute portions, which remain confined in the centre of pieces too large to allow of the heat penetrating and vaporizing them, the greater part of the water must evaporate without any useful result; and, on the contrary, with the loss of fuel, before the limestone has acquired the temperature requisite for its decomposition. M. Gay-Lussac thus concludes:—I am certainly convinced that the vapour of water favours the calcination of limestone, but I am doubtful as to its possessing real advantages, because there is not a great difference in the temperature at which it decomposes alone or with the vapour of water; besides, if the vapour of water only exerts a mechanical action similar to that of atmospheric air, any important advantage which it possesses over the aeriform current continually passing over the burning mass, is not evident. The readier decomposition of carbonate of lime by the access of aqueous vapour, or rather by means of a vacuum, cannot be considered as an isolated fact. It may be regarded as an established principle, that when one or several gaseous products are obtained, either by the action of heat or a chemical agent, the decomposition may be generally facilitated by keeping the bodies in vacuo, or by preventing the gaseous fluids from pressing upon it. And on the other hand, the decomposition may be retarded or entirely prevented, by forming round the body a sufficient pressure of an elastic fluid of the same nature as that which is to be disengaged It is thus in the curious experiment of Sir James Hall; carbonate of lime was fused at a very high temperature, without being decomposed, under the influence of a sufficient pressure of carbonic acid.*

PREPARATION OF IODINE.

By M. Bussy.

THE process of extracting iodine generally followed, and which consists in decomposing the mother-waters of kelp by means of concentrated sulphuric acid, is well known to be liable to variable results, on account of a portion of the iodine coming over in the state of the hydriodic acid and chloride of iodine, so that in either case there is always a considerable loss.

To avoid this inconvenience, M. Soubeiran proposed to precipitate the iodine from the mother-waters by means of sulphate

* Ann. de Ch. et de Ph. lxiii. 219; quoted in Jameson's Journal, No. 45.

of copper, and afterwards to decompose the iodide of copper by peroxide of manganese at a high temperature.* But this process requires minute attention and much precaution to separate the whole of the iodine existing in the mother-waters, and we do not believe that it has ever been employed in any manufactory.

These circumstances induce me to publish a far more simple method, which has been lately employed by some manufacturers of iodine; it was discovered, (if we are rightly informed), by M. Barruel, director of the chemical works at the Faculty of Medicine; it consists in precipitating the iodine of the mother-waters of kelp by a current of chlorine.

In this process the mother-waters are first to be evaporated to dryness, and to the residue there is to be added a tenth of its weight of powdered peroxide of manganese; the two substances are to be perfectly mixed, and subjected to a dull red heat in an iron vessel, frequently stirring them; the object of this calcination is to convert the sulphurets and hyposulphates, of which the mother-waters contain a large quantity, into sulphates. It is extremely easy to determine when these compounds are converted into sulphates by taking a small quantity of the calcined matter and pouring upon it an excess of sulphuric acid. It ought not to yield, when the conversion is perfect, either sulphuretted hydrogen or a deposit of sulphur. If violet vapours are disengaged during the calcination, the heat must be lowered to avoid loss. When the sulphurets are decomposed, the residue is to be dissolved in a sufficient quantity of water to give a solution of sp. gr. 1·333; through this solution there is then to be passed a current of chlorine gas, taking care to stir it constantly with a glass rod: the liquor becomes of a deep brown colour, afterwards turbid, and deposits iodine in the form of a black powder; it is to be collected and distilled in a glass retort, in order to procure it in crystals. The only difficulty in this process is to determine the point at which the action of the chlorine should cease, that no excess may be used which would react upon the iodine precipitated. This excess of chlorine is especially to be apprehended, when it is also intended to separate from the same mother-waters the bromine which they contain.

In order to avoid adding excess of chlorine, the liquor which is supposed to be near saturation, may be suffered to settle for a short time, and the current of chlorine being interrupted it is to be directed on the surface of the liquid. If it contain any iodide in solution, a pellicle of iodide will be observed to form on the surface: this effect is not produced when all the iodine is precipitated; in the latter case the liquor becomes quickly clear and retains only a reddish tint.†

* Journ. de Pharmacie, tom. ii. p. 411.
† Philosophical Magazine, No. 63.

PREPARATION OF BROMINE.

By M. Bussy.

THE separation of bromine, as usually performed, also involves great difficulties, which may be avoided by the following process.

This process greatly resembles the preceding one: it is founded, like it, upon the great affinity of chlorine and the property which it possesses of displacing bromine from its combinations. It also includes the employment of the mother-waters of iodine, which without it are useless. Take the mother-waters of kelp, after having separated the iodine by chlorine as above described. These mother-waters contain a metallic bromide, when care has been taken to avoid the use of more chlorine than sufficient to precipitate all the iodine. Add to 1,250 parts of these mother-waters, thirty-two parts of powdered peroxide of manganese, and twenty-four parts of sulphuric acid of sp. gr. 1·848: the whole is to be put into a tubulated glass retort, to which a tubulated receiver is to be adapted, and to this a tube which is immersed in a test tube. The retort and the receiver, as well as the receiver and the tube, ought to fit sufficiently well without the use of lute or corks, as they would be inevitably destroyed by the action of the chlorine. All being thus arranged, the retort is to be heated, so as to boil the liquid; the bromine condenses in the receiver in the form of red oily striæ, with a small quantity of water; the operation is to be discontinued when red vapours cease to be produced. On heating the receiver gently, without dismounting the apparatus, the bromine will pass into the test-tube, where it will condense on cooling.

The mother-waters which have been made use of may be rejected, on ascertaining by the addition of a fresh quantity of sulphuric acid and peroxide of manganese that they contain no more bromine.*

VOLTAIC COMBINATIONS.

ON April 6 and 13, a paper was read before the Royal Society, entitled "Further Observations on Voltaic Combinations;" in a letter addressed to Michael Faraday, Esq., D.C.L. F.R.S., Fullerian Professor of Chemistry in the Royal Institution, &c. &c." By John Frederick Daniell, Esq., F.R.S., Professor of Chemistry in King's College, London.

In the course of an inquiry into the effects of changes of temperature upon voltaic action, the author was led to observe some curious disturbances and divisions of the electric current produced by the battery, arising from secondary combinations; the results of which observations form the subject of the pre-

* Journal de Pharmacie; quoted in the Philosophical Magazine, No. 63.

sent paper. He found that the resistance to the passage of the current was diminished by dissolving the sulphate of copper which was in contact with the copper in the standard sulphuric acid, instead of water. The increased effect of the current, as measured by the voltameter, was farther augmented by the heat evolved during the mixture; and wishing to study the influence of temperature in modifying these effects, the author placed the cells of the battery in a tub, filled with hot water. On charging the cells with a solution of muriate of ammonia in the interior, and aqueous solution of sulphate of copper in the exterior compartment, he observed that a portion of the current is discharged by the water in which the apparatus is immersed; its passage being indicated by the disengagement of gas betwixt the adjacent cells; in which case, one of the zinc rods is thrown out of action, and the copper of that cell acts merely as an electrode to the antecedent zinc. A saturated solution of common salt was next placed in contact with the zinc, while the exterior compartments of the cells were filled with a saturated aqueous solution of sulphate of copper; but the effects were much diminished. It thus appeared that the substitution of solutions of the muriates for dilute sulphuric acid was in every way disadvantageous; and it was moreover found that, when the circuit was broken, the copper became seriously injured by their action, and by the formation of a sub-muriate of that metal.

Finding that the membranous tubes were unable to resist the action of the acid under the influence of high temperatures, the author substituted for them tubes of porous earthenware, of the same texture as that of which wine coolers are commonly made, closed at their lower ends, and of the same height as the copper cells. The bottoms of the latter were fitted with sockets, for the reception of the tubes, and for confining them in their proper places; the perforated copper plates, or colanders, which held the solid sulphate of copper, passing over their upper ends. The tubes can be easily removed, and instantly replaced; and the facility of emptying and refilling them renders the addition of siphon-tubes unnecessary, except in very particular circumstances. A circular steam-vessel of tin plate was then provided, around which the cells could be placed upon blocks of wood, and closed in with a cover, containing a socket, which could, at pleasure, be connected with the steam pipe of a boiler. Two other sockets were also conveniently placed, provided with cork stoppers, through which the electrodes of the battery could pass, when the proper connexions were made. By using this apparatus the author determined that the increase of effect consequent on an augmentation of temperature is but in a slight degree dependent on an increase of conducting power in the electrolyte, but arises principally from its increased energy of affinity, producing a greater electromotive force.

In heating the battery by the steamer, it frequently happened

that, when the thermometer had nearly reached the boiling point, and the action of the battery was at its maximum, a sudden cessation of its action would take place: and this suspension of power would continue for hours, provided the high temperature were maintained. On turning off the steam, and quickly cooling the apparatus, the action would return as suddenly as it had ceased, though, generally, not to the full amount. On closely examining the voltameter, on these occasions, it was found that the current was not wholly stopped; but that there existed a small residual current. This residual current was observed to be often directed in a course opposite to that which had before prevailed; and it was, in that case, the excess of a counter current, arising from a force which was acting in the contrary direction. The author found that variable currents might be produced, under ordinary circumstances, from the separate single cells of the battery when the whole series is connected by short wires. He proved by a series of experiments that the deoxidation of the oxide of copper by the hydrogen is not the exciting cause of the secondary currents; but that when the course of the main current of the battery is obstructed by causing it to pass through the long wire of a galvanometer, or through the electrolyte of a voltameter, the course of the secondary current from each separate cell is always normal, or in the same direction; when, on the other hand, the battery-current is allowed to flow with the least possible resistance, as by completing the main circuit by a short wire, the secondary current of the separate cells is in the opposite direction. Hence the resistance may be so adjusted as that the secondary current shall altogether disappear, or alternate between the two directions.

The remainder of the paper is occupied with the detail of experiments made with a view to ascertain the effects of different degrees of resistance to the voltaic currents under a great variety of circumstances.*

ILLUMINATING LIGHT-HOUSES.

On May 4th, a paper was read before the Royal Society, on the adaptation of different modes of illuminating Light-houses, as depending on their situations and the object contemplated in their erection. By William Henry Barlow, Esq., in a Letter addressed to Peter Barlow, Esq., F.R.S., and communicated by him.

The letter of Mr. W. H. Barlow, addressed to his father, in which the paper is contained, is dated Constantinople, March 14, 1837, and states that the experiments which he made with the Drummond light, and other means of illuminating Light-houses, and of which he now communicates the results, were undertaken

* Philosophical Magazine, No. 65.

at the request of the Turkish Government, with the view of placing lights at the entrance of the Bosphorus from the Black Sea.* The object of his inquiry is to investigate the principles on which the illuminating power, resulting from the employment of reflectors, and of lenses, depends; and the most advantageous application of that power to the purposes of Light-houses.

In discussing the relation which exists between the illuminating power and the intensity of an artificial light, he observes that the former is proportional to the quantity of light projected on a given surface at a given distance; and that the latter is dependent on the quantity of light projected by a given area of the luminous body on a given surface at a given distance. Hence the intensity of a light multiplied into its surface is the measure of the illuminating power, whether the light proceed from one or from several luminous bodies: and the illuminating power is equal to that of a sphere of light, whose intensity and apparent surface are equal to that of the light itself at any given mean distance.

Within a certain limit of distance, the property of light which produces the strongest impression on the eye, is its intensity; but when the light is so remote that the angle subtended by it at the eye is very minute, as is generally the case in Light-houses, the intensity of the impression made on the retina is proportional only to the illuminating power. The mathematical investigations of the author lead him to the conclusion that all reflectors and lenses of the same diameter have the same illuminating power when illuminated by the same lamp; and that by diminishing the focal distance, and intercepting more rays, the illuminating power is not increased, but simply the divergence, and consequently the surface or space over which it acts. The author then proceeds to inquire into the comparative utility of lenses and reflectors, and arrives at the inference that the advantage gained by the employment of the former does not arise from their superior perfection as optical instruments, but from their using the light more economically, in consequence of their producing less divergence of the rays, both horizontally and vertically, and illuminating a much smaller space in the horizon. Rules are then deduced for the application of lenses and reflectors in Light-houses, according to the particular situations in which they are placed, and the purposes they are intended to serve. With this view, the author divides Light-houses into three classes: the first comprising Beacon or Warning Lights, placed in order to prevent the approach of vessels, and which consequently can never be nearer than three or four miles; the second being Guiding or Leading Lights, placed to guide a vessel, and therefore admitting of a very near approach; and

* In the Arcana for 1837, page 99, will be found a letter from Mr. Barlow, describing some of his preliminary trials at Constantinople.

the third including those which, according to the respective directions in which they are seen, have both these duties to fulfil. In the first we require great illuminating power, and a long duration of the brightest period, with a small angle of vertical divergence: in the second, less illuminating power, but a larger angle of vertical divergence are requisite, while the duration of the extreme brightness is of minor importance; and in the third, all these properties, namely, great illuminating power, a long duration of the brightest period, and a large angle of vertical divergence, are necessary.*

PHENOMENA OF LIGHT.

On May 11 and 25, a paper was read before the Royal Society, entitled "On the connexion between the Phænomena of the absorption of Light and the Colours of thin Plates." By Sir David Brewster, K.H., F.R.S.

The phenomena of the absorption of light by coloured media have been regarded by modern philosophers as inexplicable on the theory of the colours of thin plates, and therefore irreconcileable with the Newtonian hypothesis, that the colours of natural bodies are dependent on the same causes as the colours of thin plates. The discovery by Mr. Horner of a peculiar nacreous substance possessing remarkable optical properties, of which the author has already given an account,† furnished him with the means of instituting a more accurate comparison between these two classes of phenomena. By a careful and minute analysis of the reflected tints of its three first orders of colours exhibited by a single film of the above mentioned substance, they were found to consist of that part of the spectrum which gives the predominating colour of the tint mixed with the rays on each side of it. In analyzing the transmitted beam, bands of the colours complementary to the former are seen, with intervening dark bands; and when the analysis is made with a high magnifying power, the spectrum is observed to be crossed throughout its whole extent with alternate dark and coloured bands, increasing in number and diminishing in magnitude with the thickness of its plate. In the phenomena of periodical colours there are three peculiarities demanding notice; first, that the dark lines change their places by varying the inclination of the plate: secondly, that two or more lines never coalesce into one; and thirdly that the colour of the luminous bands in the complementary spectrum are the same as those of the original spectrum when the thin plate is perfectly colourless. The author institutes a comparison of these phenomena with those of absorption as exhibited by a solid, a fluid, and a gaseous body; employing as an example of

* Philosophical Magazine, No. 65.
† Philosophical Magazine, vol. x. p. 201.

the first, smalt blue glass; of the second, the green sap of vegetables; and of the third, nitrous acid gas. No connecting link between these phenomena appeared to exist, excepting that both exhibited a divided or mutilated spectrum; but even this common fact has not the same character in both. The nacreous substance described by Mr. Horner, however, in some cases, when the plates were small, was found to produce bands perfectly identical with those of thin plates; while in other cases the bands were exactly similar to those of coloured media. By employing the iridescent films of decomposed glass, the author obtained combinations of films which gave, by transmitted light, the most rich and splendid colours, surpassing every thing he had previously seen among the colours either of nature or of art. These facts have proved that the transmitted colours, though wholly unlike those of thin plates, are yet produced by the same causes, and are residuary, and generally complementary to the sum of the reflected tints. Thus the author has succeeded in completely identifying in their primary features the two classes of acts; the one resulting from absorption, the other from periodic action. The minor points of difference, namely, the uniformity of the bands and tints of absorbing media at all incidences, and the non-appearance of the reflected tints in such media, are endeavoured to be explained by the introduction of several considerations, the complete discussion of which the author reserves for the subject of a future paper. From the phenomena of thin plates, of polarized tints, and of absorption, the existence of a new property of light is deduced, in virtue of which the reflecting force selects out of differently coloured rays of the same refrangibility rays of a particular colour, allowing the others to pass into the transmitted ray; a principle not provided for in either of the theories of light to which the phenomena of absorption are ultimately referable, and furnishing an explanation of certain remarkable phenomena of dichroism in doubly refracting bodies, in which rays of the same refrangibility, but of different colours, pass into the ordinary and extraordinary pencils.*

ANALYSIS OF CITRIC ÆTHER.

By M. Malaguti.

THE process recommended to obtain this æther is the following: take 90 parts of crystallized citric acid, 110 of alcohol of sp. gr. 0·814, and 50 of concentrated sulphuric acid. Put the citric acid, powdered, and alcohol into a tubulated retort, then add the sulphuric acid in small portions. Heat the mixture gradually to ebullition, and stop the process, when a very sensible disengagement of sulphuric æther occurs, which happens when about

* Philosophical Magazine, No. 65.

one third of the volume of the alcohol employed is distilled: the residue is to be removed from the retort, and twice its volume of distilled water is to be added to it: an oily matter almost instantaneously collects at the bottom of the vessel, which is citric æther: it must be repeatedly washed with cold water, and afterwards with a dilute alkaline solution. When the liquid which floats upon the æther leaves no residue on drying, the washing is to be discontinued, and the æther is to be dissolved in alcohol; this solution, which has considerable colour, is to be digested with pure animal charcoal: it is then to be filtered, and the dessication is to be finished in vacuo. If 8-6·10 oz. avoirdupoise be employed, the experiment requires only about an hour for its completion, and the product amounts to above 5¼ oz. Pure citric æther is liquid, transparent, of an oily consistence, and a yellowish colour. Its smell somewhat resembles that of olive oil, its taste is bitter and disagreeable, and its density 1·142; it is volatile, but the temperature at which it volatilizes is so near that at which it decomposes, that it cannot be distilled without the decomposition of a large portion of it. If it be heated in an open vessel, it emits a very dense vapour, which inflames on the approach of flame, and a coaly residue is left. In close vessels it begins to lose its limpidity at about 248° Fahrenheit, becomes reddish at 518°, and begins to boil and to decompose at about 542°; an oily matter being disengaged, afterwards dilute alcohol, lastly carburetted gases and citric æther, (acid ?); the residue is charcoal.

Citric æther is perfectly neutral, leaving no residue after combustion: it is soluble in æther, in weak alcohol, and even slightly so in water. An aqueous solution of citric æther becomes acid after some time, and much more quickly so if heated. If citric æther be boiled with a solution of potash or soda, alcohol is obtained, with citrate of the alkali. Solution of ammonia has no immediate action, nor has the dry gas. Neither barytes nor stronian water renders either citric æther, or a fresh solution in water, turbid. Nitric acid dissolves it cold, and if the solution be poured into water, the æther does not separate. When the nitric solution is gently heated, a brisk action occurs, which goes on spontaneously; there is a disengagement of red vapours, and the residue has a smell resembling that of hyponitrous acid. If considerable quantities be acted upon, and the ebullition be long continued, oxalic acid is found in the residue; this residue, which is slightly yellow, becomes of a deep red when saturated with ammonia.

Concentrated sulphuric acid immediately imparts colour to citric æther; it dissolves it cold, but quits it on the addition of water, and the æther is unchanged. The sulphuric solution when heated to about 158°, begins to exhibit appearances of a reaction, which becomes extremely strong as the temperature increases: there is a disengagement of alcohol and sulphuric

æther, and the residue is red, transparent, very thick, and soluble in water.

Hydrochloric acid dissolves citric æther cold, as the other two acids do, and quits it on the addition of water The hydrochloric solution does not exhibit any appearance of reaction; the liquid boils, hydrochloric æther is disengaged; a little alcohol, and no citric æther, remain in the residue.

Potassium put in contact with citric æther occasions disengagement of a gas; but the action stops as soon as the surface of the metal is oxidized, which very soon occurs: whether this action is occasioned by the decomposition of the æther, or of a little water which it may contain, was not determined.

By analysis this æther yielded, nearly,

Hydrogen	7·29
Carbon	51·00
Oxygen	41·71
	100·

If constituted of an equivalent of citric acid 58 and an equivalent of æther, 37, it would consist of

Seven equivalents of Hydrogen	7	or	7·37
Eight equivalents of Carbon	48	,,	50·52
Five equivalents of Oxygen	40	,,	42·11
	95		100·

This agrees very nearly with Malaguti's analysis, and perfectly with his symbolic representation of its constitution, the weights representing the equivalents varying slightly.*

SIMPLE MODE OF EXHIBITING NEWTON'S RINGS, AND A MODE OF EXHIBITING THE FIXED LINES IN THE SPECTRUM.

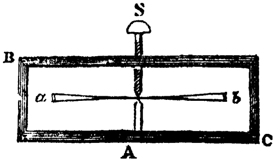
By the Rev. W. Ritchie, LL.D., F.R S., Professor of Natural Philosophy in University College, &c.

1. To exhibit Newton's rings, a lens of a long focal distance is generally considered necessary, which is both expensive and difficult to obtain. In a lecture which I delivered nearly two years ago in the Royal Institution, I showed a very simple mode of performing the experiment, which, I have no doubt, will be acceptable to many of your readers. Take two circular pieces of thin plate glass, (Dutch plate,) about six or eight inches diameter.

Gild a ring of one of the plates about a quarter of an inch broad from the circumference of the circle with gold leaf, place the plates over each other, and by means of a rectangular frame of iron or brass and a screw, bring the plates to touch in the

* Ann. de Ch. et de Phys.; quoted in the Philosophical Magazine, No. 65.

centre. *Let a b represent the glass plates,* B C the rectangular *frame,* S a screw, and A a projecting point.



By means of the screw the plates will be brought to touch in the midlde, whilst they are separated at the circumference by a single gold-leaf. When this is held so that light from the sky or a lamp falls obliquely on the plates so as to be reflected by the under plate to the eye, the rings will present themselves in circles round the dark spot in the centre.

2. Procure a prism of good flint glass, having one of its angles containing 70 or 80 degrees. Place two thin slips of metal with smooth edges in an opening in a window-shutter, through which the white light of the clouds is admitted. View this *film* of light through the *large* angle of the prism kept close to the eye, and the principal fixed lines as well as many of the others will be distinctly visible. If a bottle containing nitrous gas be placed opposite the opening, the lines will become more strongly marked and more numerous. With one of my finest prisms this spectrum appears like a piece of *striped* cloth.*

ON THE COMBINATIONS OF AMMONIA WITH ANHYDROUS SALTS.

M. Rose has examined a considerable number of the compounds which dry ammonia forms with anhydrous salts, volatile metallic chlorides, and oxacides, with the view of ascertaining the general laws to which those combinations are subject.

Their preparation is very simple, but requires time; the ammonia should be passed into a vessel containing caustic potash or lime, and then through a tube filled with caustic potash in small lumps, before it comes in contact with the salt, which is weighed before the operation, the current of ammoniacal gas being continued as long as the salt increases in weight. The combination is usually effected in the cold, and if the substance becomes heated the current of gas must be decreased. The absorption is at first very rapid, but becomes slower by degrees, so much so, that even with those substances which absorb ammonia with avidity, the operation often requires two days. We shall describe the general properties without going into the details of all the compounds examined by M. Rose.

The sulphates of manganese, zinc, copper, nickel, cobalt, cadmium and silver, and the nitrate of the last metal, absorb ammonia; on the contrary, the sulphates of magnesia, nitrates of soda and barytes, phosphate of copper and bichromate of potash do not unite with this alkali. Among the combinations

* Philosophical Magazine, No. 60.

of chlorine with the metals whose oxides are basic, there are many which act with ammonia in a precisely similar manner to the oxacid salts; such are the chlorides of calcium, strontium, copper, nickel, cobalt, lead, silver, the proto and per chloride of mercury, protochloride of antimony, the perbromide, periodide, and cyanide of mercury. The cyanuret of iron and potassium does not absorb ammonia, nor is it when cold at all acted upon by it. From his numerous researches M. Rose draws the following conclusions: many oxides, and many chlorides whose oxides form bases, can combine with ammonia, but there are some which do not possess this property although they resemble the former class in many points. When an anhydrous salt unites with ammonia it always forms a determinate compound. Salts which agree in many of their properties absorb ammonia often in the same, very often also in different proportions, so that the combinations of anhydrous salts and ammonia do not come under any law so constant as to admit of an *a priori* calculation of their relative proportions in a compound. Ammonia acts with anhydrous salts and the metallic chlorides analogous to them, as an extremely feeble base, abandoning almost the whole of them, mostly or altogether, when they are exposed to the air, or a very gentle heat: the only exceptions are combinations with perchloride and perbromide of mercury which do not give off ammonia when heated, which property necessarily places them amongst a particular class of ammoniacal compounds.

The combinations of ammonia with the oxacid anhydrous salts and the analogous metallic chlorides present a striking resemblance to the compounds which the same salts form with water. Thus water does not combine with all salts, and even amongst those whose properties are extremely analogous some will be found containing, and others not containing, water. Thus chloride of calcium absorbs a large quantity of ammonia whilst chloride of barium combines with none; sulphate of lime also unites with water of crystallization, whilst sulphate of barytes does not contain any. Besides, the water of crystallization exists in a determinate proportion in all its combinations with salts: yet salts possessing very similar properties often combine with very different proportions of water. Finally, water in its combination with salts may be considered as a base, although a very weak one, and which can be usually expelled by a moderate heat.*

OXALHYDRIC ACID OF M. GUERIN.

M. Erdmann of Leipsick considers that the composition of the acid obtained by the treatment of sugar (acide oxalhydrique of

* Journal de Pharmacie; quoted in the Philosophical Magazine, No. 65.

M. Guérin, artificial malic acid,) is the same as tartaric acid; for if a solution of this acid is allowed to stand for some time it is converted into common tartaric acid, the oxalhydrates are converted into common tartrates, and the crystallized oxalhydrate of ammonia described by M. Guérin is a tartrate of that base. A further examination has proved that this acid is identical with the isomeric tartaric acid of M. Braconnot obtained by the fusion of common tartaric acid. M. Liebig has procured well-formed crystals of tartaric acid from an acid syrup remaining after the preparation of oxalic acid from sugar and nitric acid which had been left to itself for a length of time. These researches will remove all the anomalies of the oxalhydrates of M. Guérin.*

CARBOVINATE OF POTASH.

MM. DUMAS and Peligot by passing a current of dry carbonic acid into a solution of barytes in pyroxylic spirit, (*l'esprit de bois*,) obtained carbo-methytate of barytes. The production of this compound led them to suppose that the preparation of the carbovinates would be attended with but little difficulty. When, however, this idea was put in practice, they were interrupted by the discovery that although pyroxylic spirit dissolves anhydrous barytes, yet alcohol does not possess this property; they therefore tried whether the use of an alcoholic solution of ammonia would not be attended with success. By passing a current of dry carbonic acid through a solution of anhydrous ammonia in absolute alcohol a salt was obtained, but it did not possess the properties of carbovinate of ammonia. They then tried the action of dry carbonic acid on a solution of potash which had been heated to redness, in absolute alcohol. As the operation is attended with the evolution of heat, it is necessary that it should proceed slowly and the vessel be kept cold in which it is conducted. The crystalline substance formed by this action soon becomes so abundant as to solidify the solution; a volume of anhydrous æther equal to that of the solution must then be added, and thrown upon a filter. By washing the product with anhydrous æther there remains a mixture of carbonate, bicarbonate, and carbovinate of potash. To separate the last salt the mixture must be washed with absolute alcohol, which dissolves it, and anhydrous æther added to the filtered solution, which reprecipitates it. This liquor immediately filtered and dried *in vacuo* affords pure carbovinate of potash. The analysis of this salt indicates exactly the following formula:

$$KO, C^2 O^2; C^8 H^4, C^2 O^2, HO.$$

This salt is in shining scales. It decomposes by heat into carbonic acid, an inflammable gas, an æthereal fluid, carbonate

* L'Institut.; quoted in the Philosophical Magazine, No. 65.

of potash, and charcoal. Dissolved in water it is rapidly converted into bicarbonate of potash. Dissolved in weak alcohol, or even if it contains only slight traces of water it suffers the same decomposition, and deposits the bicarbonate in shining plates resembling the carbovinate, consisting, however, of

$$KO, C^2 O^2; HO, C^2 O^2.$$

This rapid and easy conversion of carbovinate into bicarbonate of potash affords but slight hopes of the possibility of isolating the acid, but it is evident that such an acid does exist; and its properties may be interesting as relative to the theory of fermentation.*

NEW VOLTAIC BATTERY.

By Mr. James Young, Chemical Assistant in the Andersonian University.

A PLAIN working battery, containing a considerable number of pairs of plates, arranged on the principle of the pile of Volta or the trough of Cruickshanks, is the instrument which we habitually have recourse to for illustrating chemical decompositions, and the other effects of voltaic electricity requiring considerable tension. Various constructions of this battery are in use, of which we are concerned only with that originally suggested by Dr. Hare, but of the value of which electricians were not aware till it was clearly demonstrated by Mr. Faraday. The existence of a defect, however, is fully admitted by Mr. Faraday, in the construction which he recommends. To prevent metallic contact between contiguous copper plates, cartridge paper is interposed between them. The paper becomes saturated with the acid solution used as the exciting liquor, and the acid cannot be washed out of the paper, but is retained by it after the battery is laid aside, and may then occasion the solution of the copper, seeing that zinc no longer enters into a circle with the acid and copper, and therefore the latter is unprotected. These papers require likewise to be renewed occasionally, and they give to the construction the character of a temporary arrangement. It is true that glass or porcelain plates may be placed between the contiguous coppers; but these are inconvenient; and, in fact, bring us back to the old construction of the trough partitioned into cells. It is to be noticed too that these copper surfaces, with the paper between them, are lost, and turned to no account in collecting electricity

After constructing several batteries with the interposed papers, and becoming fully sensible of the annoyance which the papers occasion, an arrangement of the plates suggested itself which does not require interposed papers, and in which both surfaces of the copper as well as of the zinc plates are made available.

* L'Institute; quoted in the Philosophical Magazine, No. 67.

Within the last eighteen months I have constructed several dozens of instruments of the construction to be described, and having compared them experimentally with batteries of the same extent of copper and zinc on Dr. Hare's construction, I am prepared to state that, from the same surfaces of zinc, electricity *the same in quantity and tension is produced in both forms, but that in the new construction this effect is produced with half the quantity of sheet copper, which arises from both sides of the copper plates being presented to surfaces of zinc.* The new construction has, I believe, all the advantages of approximation of the plates and compactness of Dr. Hare's battery, which have been pointed by Mr. Faraday, without the great and acknowledged drawback of the interposed papers.

Fig. 2.

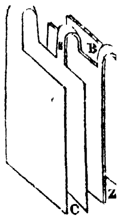


Fig. 3.

Fig. 1.

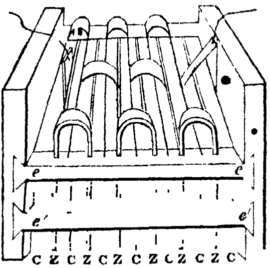


Fig. 4. Fig. 5.

(Mr. J. Young's Voltaic Battery.)

The sheet copper and sheet zinc to be used in this battery are first cut into long ribbons, of the breadth which it is intended to give the plates. Suppose the ribbons two inches broad; both the copper and zinc ribbons are then divided into lengths of five inches, and a portion cut out as in Fig. 1. The slip is thus divided into two squares of two inches each, which are connected at A, and a piece is left projecting at B. The zinc and copper sheets are cut up exactly in the same way. Fig. 1, therefore, represents either a single zinc or a single copper plate. The plate is then bent at A, and presents the appearance represented in fig. 2. In fig. 3, we have two plates, one of copper C, and the other of zinc Z, which are exactly alike in construction, but are placed differently, as shown in the figure. Thin projecting parts B B are soldered together, and this is the only metallic communication between them which is allowed to exist. Fig. 3, therefore, is only one copper and one zinc plate, or it is one pair of plates. Each pair is made up in the same way.

In arranging a number of pairs to form a battery, they are interlaced so that a copper square comes in between each couple of zinc squares, and a zinc square between each couple of copper squares. It is easy to see how this arrangement can be made when the plates are in the hand, though it is difficult to describe it. At the positive end of the battery there is a single copper plate, which is soldered at the top to the last double copper plate, as seen in fig. 4; which figure represents three pairs properly arranged, and also the manner in which they should be fitted up and kept steadily apart in a wooden frame. This frame consists of two cross-bars, *e e*, *e′ e′*, in front, and the same behind, dovetailed into solid ends. The channels in the cross-bars, for the reception of the edges of the plates, are formed by placing the four cross-bars together, and sawing a little way into one side of them all, every eighth of an inch or so in their length, so as to form a set of parallel grooves. We have by means of this frame a much greater security that no metallic contact will occur between contiguous plates, than when they are separated by wedges of cork, as in Dr. Hare's construction, which may slip out.

The frame and plates are introduced into a trough, which may be of wood or stoneware, containing the exciting liquor. Dr. Hare's revolving arrangement of the two connected troughs may be adopted for this battery, although we have been led to give a preference in practice to a single trough to contain the frame. To the solid ends of the frame are attached two cords, which are fixed to two pulleys, on which they are wound up, on turning a winch, as represented in fig. 5, by which means the frame and battery can be raised out of the fluid. If the axis, (a stout wire), on which these pulleys are fixed can be moved a little backwards and forwards on its bearings, it is easy, by means of a little projecting peg at P, which fits into a hole in the side of the pulley, to fix and support the frame in a position above the trough, and out of the exciting fluid, when that is desirable. But the form of the trough to contain the frame and plates may be varied according to the object in view, or the purposes to which the battery is to be applied.

In comparing a battery of the form described above, either with Dr. Hare's or any of the other forms in use, it is to be remembered that the plates or elements of the battery are all of double the size they appear to be, or that in this construction you have half the number of pairs, but each of double the dimensions of a pair in any of the old batteries having the same appearance.

A small battery of this construction, containing twelve pairs, of two inches breadth, of plates, (the size which we have taken above as an example,) may be contained in a trough eight inches in length, and will evolve, when its terminal wires are soldered to a Faraday's volta-electrometer, six or seven cubic inches of the mixed gases in three or four minutes, with a charge of half an ounce of sulphuric acid and half an ounce of nitric acid, in twenty-four ounces of water, (all by fluid measure, and is therefore amply sufficient to demonstrate the decomposition of water on a considerable scale.

It is proper to use the thickest sheet zinc which can be had, in the construction of the plates, although the thinnest sheet copper will suffice, from its being so well supported. When the zinc

plates are worn out, the cross-bars may easily be pulled out of the solid ends, and the elements of the battery separated. New zinc plates being soldered to the old coppers, the whole may again be quickly rearranged in the old frame.*

PREPARATION OF SULPHURET OF CARBON.

M. MULDER directs, in an iron bottle in which mercury is imported, that besides the hole which is already there, another should be bored near it. Into the first of these openings a copper tube bent twice at right angles is to be screwed, and into the second a straight tube, also of copper, is to be introduced. Then the bottle is to be filled with pieces of charcoal, recently heated to redness, of such a size that they can easily pass down the tube. After having firmly screwed in the straight and curved tubes, place the bottle in a furnace and heat it, after having closed the opening of the furnace with a stone cut in halves to prevent inconvenience to the operator from the ascending heat.

Adapt to the curved tube a Woulff's bottle half filled with water and surrounded with a freezing mixture. and when the iron bottle is sufficiently heated, introduce by the straight tube fragments of sulphur and immediately close the mouth of the tube with a plug; the sulphur fuses, and falling upon, penetrates the pieces of charcoal, and when the sulphur is gradually added, but little gas is evolved and abundance of sulphuret of carbon is obtained.†

CONVERSION OF IRON INTO PLUMBAGO BY SEA-WATER.

M. DESLONGCHAMPS has found lying near La Hogue, where the naval battle was fought, some cannon balls, which although they do not appear externally to have undergone any change, yet have lost two-thirds of their weight and may be cut with a knife like a black-lead pencil: they contain no iron in the metallic state, and exert no influence on the magnetic needle.‡

EXPERIMENT IN ELECTRICITY.

By James Watson, Esq.

THE following experiment may easily be made by any person who has an electrical machine.

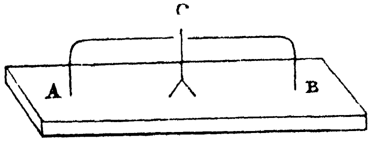
Take a slip of card about one inch in length and one quarter of

* Philosophical Magazine, No. 61.

† Journal de Pharmacie; quoted in the Philosophical Magazine, No. 66.

‡ Journal de Chim. Méd; quoted in the Philosophical Magazine, No. 67.

an inch in breadth, and at one end of the card make a slit up the middle one quarter of an inch long; then bend out the divided parts in opposite directions, so that the bit of card may be made to stand upright upon its two short legs. By this means the card may be so nicely adjusted that a very slight touch will overbalance it, and cause it to fall. Now take two pieces of stout brass wire, four inches in length and pointed at each end; bend the wires at right angles, in order that each wire may have a short arm or stem, one inch long. These short arms or stems are to be inserted a little way into two holes made to receive them in a flat, thick piece of wood. The two holes must be made at such a distance from each other that the points of the two long horizontal arms shall be just three quarters of an inch apart. Midway between these points place the bit of card, in an upright position, as in the figure, where C represents the edge of the card,



having its two flat sides opposite to the points of the two wire A and B.

To insure success in making this delicate experiment, the machine must be screwed to a very *steady* table, otherwise the card will be disturbed by the turning of the cylinder. The best way of making the discharge is to suspend a small jar from the prime conductor, and let the jar discharge itself through the electrometer. A chain must connect the electrometer with the wire A, and another chain must connect the outer coating of the jar with the wire B.

When the experiment is well performed, the card is perforated, and has a bur on each side of it, but what deserves particular notice is the very curious fact that the card is *not thrown down*.

If two bits of card be placed between the wires, instead of one as in the last experiment, even then the separate bits of card will continue *to stand*, although both will be perforated.

The motion of a single fluid from the positive to the negative wire, cannot, I think, be reconciled with my experiment, which seems to require *two equal* repulsive actions.*

FOSSIL INFUSORIA USED FOR FOOD.

It appears from a letter addressed to Ehrenberg by Prof. Retzius of Stockholm, that the mineral substance commonly called Bergmehl, mountain-meal, described and analyzed by Berzelius, and in which he found silex, animal substance, and crenic acid,

* London and Edinburgh Philosophical Magazine and Journal of Science, No. 61.

is sometimes eaten in Lapland in times of famine, when the Laplanders mix it with ground corn and bark, to make their bread. It was used thus in the district of Degerfors in 1833, and is superstitiously considered as a gift of the great spirit of forests. Retzius adds that he has discovered in the Bergmehl, nineteen different forms of Infusoria with siliceous shields, the mineral being wholly composed of them, and that the analogy which he supposed to exist between it and the Bermehl of Franzensbad seems to be well founded.*

PYROPHORI OF EASY PREPARATION.

It is well known that when 2½ parts of pure tartaric acid, deprived of its water of crystallization, are quickly mixed in a dry capsule with eight parts of peroxide of lead, perfectly dry and reduced to powder, ignition very soon occurs throughout the mass, which is very vivid and of long duration. This fact, first mentioned by Walker, would lead to the supposition that other organic substances would undergo similar reaction with peroxyd of lead; and this has been verified by the experiments of M. Bœtliger. On experimenting with the oxalic and citric acids, he found that the action of the former on the peroxyd of lead was more rapid, and perhaps stronger, than that of tartaric acid; while that of citric acid was rather weaker. Thus, on mixing together 5¼ parts of peroxyd of lead, and one part of oxalic acid dried in hot air, or containing 19 per cent. of water, almost instantaneous ignition of the mass occurs; but it continues for a much shorter time than with the tartaric acid, because the oxalic acid contains less carbon. In order to obtain a pyrophorus with citric acid, one atom of citric acid, previously fused and kept some time in fusion, then dried and pulverized, must be promptly mixed with two atoms of peroxyd of lead at the temperature of 73° Fahr. The ignition of the whole mass is almost as vivid, and continues for as long a time as with tartaric acid. Minium, litharge, and carbonate of lead, mixed with tartaric acid, yield also, according to M. Bœtliger, pyrophori, but not so good as those yielded by the pure oxyd.†

M. MOSSOTTI'S MATHEMATICAL RESEARCHES RELATIVE TO THE LAWS OF MOLECULAR ACTION.

A translation of the memoir by M. Mossotti "On the forces which regulate the internal constitution of bodies," in which he has embodied the results on this subject which he has hitherto obtained, has already appeared in Part III. of the "Scientific Memoirs." As, however, the principal result of his labours,—the mutual identification of the attractive forces of electricity, aggregation and gravitation,—constitutes one of the most re-

* Philosophical Magazine, No. 61. † L'Institute; Ibid.

markable discoveries of the present æra in science, we think it desirable to notice it as a matter of reference.

While reflecting on the Franklinian hypothesis for explaining the phenomena of statical electricity, as reduced by Æpinus to the form of a mathematical theory, and with the addition subsequently made by Coulomb, proving that electrical attractions and repulsions are regulated by the law of the inverse ratio of the square of the distance, M. Mossotti conceived the idea, that if the molecules of matter, surrounded by their atmospheres, attract each other when at a greater, and repel each other when at a less distance, there must be between those two distances an intermediate point at which a molecule would be neither attracted nor repelled, but would remain in steady equilibrium; and that it was very possible that this might be the distance at which it might be placed in the composition of bodies. Learning subsequently that the attention of geometers had recently been particularly directed to the molecular forces, as being those which may lead us more directly to the knowledge of the intrinsic properties of bodies, he was thus led to recall his ideas on the subject, and to set about subjecting them to analysis, and he has submitted to the judgment of philosophers, in the memoir here referred to, the results of his first investigations. Of the contents of this memoir the following extracts may be regarded as a summary.

"I have supposed that a number of material molecules are plunged into a boundless æther, and that these molecules and the atoms of the æther are subject to the actions of the forces required by the theory of Æpinus, and then endeavoured to ascertain the conditions of equilibrium of the æther and the molecules. Considering the æther as a continuous mass, and the molecules as isolated bodies, I found that if the latter be spherical, they are surrounded by an atmosphere, the density of which decreases according to a function of the distance which contains an exponential factor. The differential equation which determines the density being linear, is satisfied by any sum of these functions answering to any number of molecules. Whence it follows that their atmospheres may overlay or penetrate each other without disturbing the equilibrium of the æther. Proceeding in the next place to the conditions of equilibrium of the molecules, I observed that, for a first approximation, (which may be sufficient in almost all cases,) the reciprocal action of two molecules and of their surrounding atmospheres is independent of the presence of the others, and possesses all the characteristics of molecular action. At first it is repulsive, and contains an exponential factor, which is capable of making it decrease very rapidly: it vanishes soon after, and at this distance two molecules will be as much indisposed to approach more nearly as they would be to recede further from each other; so that they would remain in a state of steady equilibrium. At a

greater distance the molecules would attract each other, and their attraction would increase with their distance up to a certain point, at which it would attain a maximum: beyond this point it would diminish, and at a sensible distance would decrease directly as the product of their mass, and inversely as the square of their distance."

"To apply the formulæ which we have found, for the purpose of presenting molecular action, to the phenomena of the interior constitution of bodies, requires methods of calculation which are not yet developed, and which must become still more complicated when the arrangement of the molecules, their form and their density, are taken into consideration. I have thought it advisable however, in consideration of the use to which it might be applied by able geometers, not to postpone the publication of this mode of viewing molecular action. It is a subject which appears to me entitled to the greatest attention, because the discovery of the laws of molecular action must lead mathematicians to establish *molecular mechanism* on a single principle, just as the discovery of the law of universal attraction led them to erect on a single basis the most splendid monument of human intellect, *the mechanism of the heavens*."*

A SIMPLE MODE OF EXHIBITING THE COLOURS OF THIN PLATES.

By James Walgom.

In the Philosophical Magazine, there is an article by the late Dr. Ritchie, entitled, "A simple mode of exhibiting Newton's Rings."—(See also p. 126.) Two circular pieces of thin plate glass, separated at the circumference by a single gold-leaf, are to be used instead of lenses; but in order to bring the glass plates to touch in the centre, we must have "a rectangular frame of iron or brass, and a screw." I am afraid, therefore, that Newton's rings, as an experiment for illustrating the colours of thin plates, are not likely to be often visible, except in diagrams.

I shall now proceed to describe a very simple mode of exhibiting the colours of thin plates by means of an experiment which requires no expensive apparatus.

We have all seen the brilliant colours which are reflected from the narrow cracks in mica, and there are little concentric coloured rings in this mineral, which may be found by using a magnifier. It occurred to me lately that possibly these splendid colours might be made to appear in the mineral whenever required. To effect this I obtained a thin plate or film of air, by introducing a lancet into the edge of a clear plate of mica, carefully separating the laminæ to the extent of about one inch square. Then holding the plate of mica with both hands, pressing the middle finger of the right hand just under the spot where the film of air was made, I was much gratified by the

* Scientific Memoirs, part III. p. 450; quoted in the Philosophical Magazine, No. 61.

appearance of several beautiful, curved lines or bands of different colours, which followed the direction in which I moved my finger. These curved lines or bands in their forms very much resemble those of a fortification agate. The perfect rings are small, but they expand or contract according to the degree of pressure. The colours also change with the pressure of the finger, and when the finger is altogether withdrawn, these beautiful tints all vanish in a moment. We have then in this easy experiment, a palpable proof that it is the distance between the surfaces only which determines the colours of thin plates.

The plate of mica which we employ should be about the size of a page in an octavo book,* and about the thickness of a card. This size is convenient to hold with both hands, and the circumference of such a plate of mica will admit of several distinct plates of air. Films should be made between different laminæ of the mineral, by which means we shall possess films of air, covered with plates of mica of different degrees of thickness.

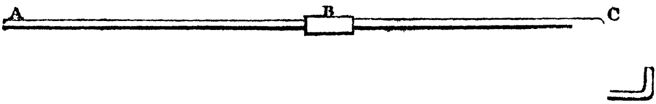
The colours may be seen very well with the naked eye, but they appear more beautiful when examined with a magnifier. The plate of mica should be held near a window, so as to reflect the light.†

METHOD OF ANALYZING ORGANIC COMPOUNDS.

By Robert Rigg, Esq., M. R. I.

HAVING been so frequently solicited by those who have seen me analyze organic compounds to make an early and more public communication than I have yet done of the method which I adopt, I publish the following brief account of my very simple apparatus, premising that if at any period I should publish my researches altogether, I shall then go into detail upon this department of chemical manipulation.

The analytical apparatus consists of two small glass tubes connected by a caoutchouc collar, as shown below:



A. A tube in which is placed the organic compound to be analyzed, and which for the analysis of one grain is from seven to ten inches in length, and from three to four tenths of a cubic inch in content.
B. A caoutchouc collar, about an inch in length, in which is put a little dry amianthus or cotton wool.
C. A bent thermometer tube, for conveying the gaseous products to the receivers standing over mercury.

The compound to be analyzed, a portion of it having been burnt in a platinum spoon with a view to determine the quantity of residual matter,

* Such plates of mica may be had of Knights, Foster Lane.
† Philosophical Magazine, No. 71.

is mixed in the usual way with black oxide of copper,* varying in quantity from thirty to fifty grains for each cubic inch of carbonic acid gas that will be formed, and varying also with the quantity of water that will be formed. This mixture is put into the clean and dry tube, and upon it an inch or more of the same kind of oxide: the tube is then filled up with from fifteen to twenty-five grains of dry amianthus, and which, during the process of decomposition, condenses the vapour of water, and dries the gaseous products. The part of the tube which includes the amianthus is then heated, so as to drive off all moisture and decomposable matter that may be combined with it, and allowed to cool, when it is weighed, and attached to the bent tube by the collar, as shown in the diagram. The bent tube is placed in the mercurial trough, and the analyzing tube rests on the frame or cradle, made of two pieces of strong wire bent at both ends at right angles, and connected together in an oblique direction by slender wires, as represented in the subjoined diagram.

A spirit lamp upon the principle invented by Mr. Cooper, and which can at pleasure be made to give off a flame from one to six, or from one to ten inches in length, and about six inches in height, is what I use. A flame, about an inch in length, is first applied to that part of the tube where no organic compound lies; so soon as this part of the oxide is brought to a red heat, the flame is gradually but very slowly increased in length, until all that part of the tube where the compound and black oxide are, is at a white heat. During this period the tube is turned round in the flame, the caoutchouc collar admitting of this being done at pleasure. At no time is the decomposition of the substance under analysis quick, but on the contrary, very slow. The ignited part of the tube being kept at a high temperature, we insure perfect combustion, and prevent the formation of carbonic oxide, which is in all probability the source of much error in quick processes.

During the latter part of the process, and when it is certain that all the atmospheric air has been expelled, a portion of the gaseous products is collected in a separate small tube graduated to hundredths of a cubic inch. When no more gass passes over, the flame is extinguished, and the contents of the tube are shifted by raising and lowering it with a view to that end, and without removing the bent tube from the mercurial trough. The whole being arranged again as at the commencement, that part of the tube which contained the compound under analysis is submitted to a higher temperature, if possible, than before.

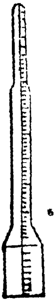
The analyzing tube is now detached from the other, allowed to cool, and weighed, and the weight lost is found to be that of the gaseous products which have passed from it, all the water having been absorbed by the amianthus.

* The black oxide, which I prepare by burning copper turnings, and not from nitrate of copper, is exposed to a white heat for an hour at least, and well stirred. I afterwards spread it on a plate, where it lies from ten to twelve hours; put it into a bottle, shake it well, and then accurately determine the quantity of air and moisture it has condensed; these remain stationary, when it is kept in stoppered bottles, during the use of two or three pounds of oxide so prepared.

The bent tube is at this time filled with the gaseous products of the analysis, and when the analyzing tube is cooled, about 2·10 of its interstices are also filled with the same, and this I take into account in calculating the products.

On heating the analyzing tube again, driving off all the moisture, allowing it to cool, and then weighing it, I have the total loss in weight to the 1·1000 of a grain, and the contents of the tube in a dry state.

I remove the carbonic acid gas by liquid potassa, and the residual gas, which is left in the small tube which is filled during the latter part of the process is first transfered into the upper part of the graduated tube represented in the margin,* and where its volume can be read to 1·2000 of a cubic inch. This I calculate for as nitrogen. The other residual gas is then transfered into the same tube, and the volume of the two read in the centre part to the 1·200 of a cubic inch. If no nitrogen is present in the compound under examination, the volume of the residual gas is less than that of the atmospheric air in the oxide, together with that which had filled the interstices of the analyzing tube, the caoutchouc collar, and the bent tube, and contains less oxygen.



The nitrogen obtained from the gaseous products which are collected in the small tube, serves as a term of comparison for verifying the results of the experiments which I make expressly for the purpose of determining the quantity of that element; and where its existence is doubtful, as, for instance, in sugar, starch, &c, I first fill the tube with carbonic acid gas, use black oxide of copper which has not been exposed to the air, apply the flame *first* to the end of the analyzing tube, and am *especially* careful that no carbonic oxide is formed.

The weight of water, and also that of carbonic acid gas and nitrogen, together with their volumes, being known, this mode of conducting ultimate analysis enables me to determine accurately the quantity of water by weight, and the quantity of carbon and nitrogen, both by weight and by volume, in any given compound. And, further, I have the data for a very accurate recapitulation of all the products, so as to be able to speak with tolerable certainty as to the correctness or incorrectness of any experiment so made, and also for testing the correctness of data already received as regards the weight and volume of the different elements contained in the compound under analysis.

The experiments that I have made with this simple apparatus are very numerous. I have before me at this time more than five hundred substances, which I have analyzed with a view to discover the chemical changes which occur during the preparation of the earth for the growth of vegetables, the germination of seeds, the vegetation of plants, the formation of vegetable products, the renovation of the atmosphere as regards both nitrogen and oxygen, and the various decompositions of vegetable matter; and many additional experiments will be required to complete the course of analysis which I find to be necessary to the purposes I have in view. The whole inquiry has reference more particularly to agriculture, to horticulture, and to some of those manufactures in which vegetable products are employed.†

* Several tubes of this kind are required in order to measure the quantities of nitrogen contained in different compounds.

† Philosophical Magazine, No. 71.

PRESENT STATE OF ORGANIC CHEMISTRY.

"It can be easily conceived, that by means of a few laws of combination, we may not only produce all the compounds known in the inorganic kingdom, from the fifty-four elements now recognised, but also a great number of others analogous to them.

"But how can we apply such notions to organic chemistry? There we meet with as many, and as diversified, species as in mineral chemistry; and yet there, instead of fifty-four elements, three, or at most four, are all that are detected in the greatest number of known compounds. In a word, how can we explain by aid of the laws of inorganic chemistry, and how class the principles so various which are obtained from organized bodies, and which are all formed solely from carbon, hydrogen, and oxygen, with the occasional super-addition of azote?"

This was a splendid problem in natural philosophy, calculated to excite the emulation of chemists to solve; for from the solution, science might expect great additions to her domain; the mysteries of vegetation and animal life would be unfolded to our view; we should possess the key to all those abrupt and singular modifications of matter which take place in animals or plants; and, what is more, we might imitate them in our laboratories.

We fear not to assert, and that with due consideration, that this splendid problem is now solved; it only remaims to develope all the consequences which its solution brings out. And, certainly, if a chemist, however great his genius, had been questioned as to the nature of organic substances, before this new path of knowledge had been opened, he never would have imagined, we are certain, any thing worthy to be compared with these simple, regular, and beautiful laws, which experiment has displayed to us within these few years.'

To produce, with three or four elements, combinations as varied, and perhaps even more varied, than those which compose the whole mineral kingdom, nature has adopted a means as simple as unexpected; for with these elements she has made compounds, which themselves possess all the properties of elementary bodies. And this, we are convinced, is the secret of organic chemistry!

Thus, organic chemistry possesses elements peculiar to it, which sometimes play the parts which chlorine or oxygen perform in the mineral kingdom, and which sometimes, on the contrary, perform the functions of the metals. Cyanogen, amidine, benzule, the compounds with ammonia for their base, fats, alcohols, and similar bodies; these are the true *elements* on which organic chemistry operates, and not upon the *ultimate elements*, carbon, hydrogen, oxygen, and azote; elements which only come forth when all trace of organic origin has disappeared.

Inorganic chemistry comprises all those bodies which result from the direct combination of *elements* properly so called.

Organic chemistry, on the contrary, comprises all the beings formed by compounds, acting as elements would do.

In the former the bases are simple, in the latter they are compound, that is the sole difference.*

VEGETABLE ORIGIN OF THE DIAMOND.

ONE of the most striking physical investigations that have lately occurred, is that of Sir D. Brewster, by which he has further shown the probable vegetable basis of the diamond. He had previously remarked several peculiarities of structure in this gem, which inclined him to assign it an organic origin. Thus, for example, having detected a bubble of air in a diamond, Sir David transmitted through it a pencil of polarized light, and perceived round the bubble four luminous sectors, separated by the black cross. Now this could only be accounted for by assigning a variable density from the centre to the exterior, greatest against the bubble of air, which must have exerted a degree of compression on the matter in contact with it. On other occasions, Sir D. Brewster had remarked in certain diamonds interposed carbonized parts. At the recent Liverpool meeting, this philosopher communicated what he conceived to be a novel phenomenon; but it has been remarked in France in the diamond lenses prepared by M. Oberhauser; namely, an infinity of very fine parallel lines, which are perceived in the diamond in a certain direction, and which are very prejudicial to its employment in the construction of lenses. These lines had been regarded in France as fibres, or as fine channels; Sir D. Brewster considers them as separating so many layers of variable densities; he counted many hundreds of them in less than the one-thirtieth of an inch, and to them he attributes the duplication of the images, which were formerly supposed to be due to an ordinary effect of double refraction. He is consequently led to imagine that if diamond lenses were worked parallel to the direction of these layers, or, so that their axis was exactly perpendicular, they would not be influenced by the presence of these lines; the lens would act precisely as if the diamond were perfectly homogeneous.

Sir David states that he has not observed this structure resulting from an assemblage of fine laminæ of varying densities in any other mineral, not even in apophyllite or chabasite,† which present different degrees of extraordinary refraction in different points of the crystal, depending on a secondary law of structure. Sir David, therefore, thinks this special structure in the diamond to be a new indication of its vegetable origin, and that it was

* From a *Memoir on Organic Chemistry*, by MM. Dumas et Liebig; translated in the Magazine of Popular Science, No. 23.

† Apophyllite is a hydrated silicate of lime and potassa, composed of one atom of ter-silicate of potassa, three atoms of ter-silicate of lime, and sixteen of water. Chabasite is 1 bi-silicate of lime + 3 bi-silicate of alumina + 4 water, or it is a hydrated silicate of lime and alumina.

formed by the successive deposition of layers submitted to different pressures.*

TEMPERATURES.

THE following interesting and useful tables are taken from the first part of Mr. Graham's *Elements of Chemistry*, just published by Baillière :—

Range of Temperature.

—135° Fahr.		Greatest artificial cold. Thilorier. (Obtained by freezing liquid carbonic acid.)
—121	——	Solid compound of alcohol and carbonic acid melts.
—91	——	Greatest artificial cold measured by Walker.
—58	——	Temperature of planetary space. Fourier.
—60	——	Greatest natural cold observed by Ross.
—55	——	Greatest natural cold observed by Parry.
—47	——	Sulphuric ether congeals.
—39	——	Melting point of solid mercury.
—7	——	A mixture of equal parts of alcohol and water freezes.
+7	——	A mixture of one part of alcohol and three parts of water freezes.
+20	——	Strong wine freezes.
+32	——	Ice melts.
+50	——	Medium temperature of the surface of the globe.
+52	——	Mean temperature of England.
+98	——	Heat of the human blood.
+150	——	Wood-spirit boils.
+174	——	Alcohol boils.
+212	——	Water boils.
+442	——	Tin melts.
+594	——	Lead melts.
+662	——	Mercury boils.
+980	——	Red heat. Daniell.
+1141	——	Heat of a common fire. Do.
+1869	——	Brass melts. Do.
+2233	——	Silver melts. Do.
+3479	——	Iron melts. Do.

Specific Heat.

	Specific Heat.		Specific Heat.
Water	1000	Zinc	93
Sulphur	188	Silver	56
Glass	117	Mercury	33
Iron	110	Platinum	31
Copper	95	Lead	29 †

NEW EXPERIMENTS ON METALLOCHROMY.‡

M. BÖTTIGER has obtained some remarkable effects in metallic coloration, by plunging a plate of platina, held in contact with a

* Magazine of Popular Science. No. 123. † Ibid.

‡ This term was adopted by Professor Nobili, who first published some highly interesting observations on the subject. See *Scientific Memoirs*, p. 1, for a translation of his paper.

zinc stem, in a solution of ammoniacal chloride of copper; the platina being consequently maintained in an electro-negative state. The solution of the copper was obtained by agitating fine copper-filings in a saturated solution of sal-ammoniac. This solution of copper, which is colourless as long as it is kept in a well-stopped bottle, becomes blue by exposure to the air. If a piece of polished platina be plunged into it no effect is produced, but if the platina be touched by a piece of zinc, a thin red pellicle of copper is immediately deposited on the surface, which immediately disappears if the contact with the zinc was momentary; but if this contact is permanent, beautiful shades of yellow, green, red, brown, and black, soon appear on the platina. These colours may be fixed by withdrawing the platina and leaving it to dry in the air.*

ACTION OF COLD AIR IN MAINTAINING HEAT.

By a Correspondent of the Magazine of Popular Science.

I WAS at Sheffield in last December, and then a Mr. Linley, bellows maker of that town, showed me the following curious experiments:—First, a rod of iron, about an inch in diameter, was heated at one end in a forge fire, up to a full white heat, then quickly withdrawn from the fire and exposed to a strong blast of cold air from a forge bellows: the iron immediately became so hot as to fuse, and the liquified matter was blown off and burnt in the air, with the scintillating appearance of iron-wire burning in oxygen gas; and so continued to melt, until a pound or more of the metal had been thus wasted.

Another mode of producing the same action, consisted in heating a rod of iron as before, but instead of a blast of air, it was tied to a cord, and by it whirled round in a vertical plane; thus, by passing swiftly through the cold air, it melted, and was thrown off in beautiful scintillations, appearing as luminous tangents to the circle in which the bar was moved.

I have since applied a heated bar of iron to the periphery of a revolving wheel, and by an including tin hoop or guard, it is thus made an interesting class experiment.

The cause of this augmentation of temperature is, I conceive, referable to the oxidation of the metal, which takes place freely under the conditions of the experiments here recorded. Then, as is well known, the formation of the oxide is accompanied with a great developement of heat; and the cases before us are striking examples of the heating influence by chemical action, predominating over the cooling effect of the air, conjoined with the radiating force.†

SALTS ACTED ON BY LIGHT.

DR. DRAPER, in his papers on "Experiments on Solar Light," published in the *Journal of the Franklin Institute*, gives the

* Magazine of Popular Science, No. 23. † Ibid.

following list of "all the metallic salts at present known, in the constitution of which, changes are brought about by exposure to the sun:"—

1. Sulphate of Nickel.
2. ——— Uranium.
3. Nitrate of Bismuth.
4. ——— Silver.
5. ——— Uranium.
6. Carbonate of Lead.
7. ——— Nickel.
8. Bromate of Silver.
9. Sulphocyanate of Iron.
10. ——— Silver.
11. Chloride of Manganese.
12. Chloride of Uranium.
13. ——— Copper.
14. ——— Mercury.
15. ——— Silver.
16. ——— Gold.
17. ——— Osmium.
18. ——— Potassium.
19. Bichloride of Mercury.
20. Iodide of Mercury.
21. Bromide of Silver.

The changes which these bodies experience are of different kinds; some become black, some bleach, some, as the sulphate nickel, undergo changes of crystalline arrangement.*

SINGULAR ACTION OF THE SOLAR RAYS.

By Dr. Draper.

THE sun's rays have the power of causing vapours to pass to the perihelion side of vessels, in which they are confined, but, as it would appear, not at all seasons of the year. For example, I have a certain glass fitted up for making these observations, and in this vessel, during the months of December, January, and part of February, 1836-37, a deposit was uniformly made towards the sun; during the months of March, April, and part of May next following, although every part of the arrangement remained, to all appearance, the same, yet the camphor was deposited on the side furthest from the sun. From May until the present date, the deposit is again towards the sun. It does not appear that any immediate cause can be assigned for this waywardness. Does it exist in the sun's light? or in changes affecting the earth's atmosphere? or in imperceptible changes in the instrument with which the observation is made? as respects the latter, I think a negative answer may be given without any hesitation; but beyond a mere expression of the fact that these anomalous circumstances do occasionally occur, I would not be understood to speak decisively; if periodic changes like this do occur, which is doubtful, they have not been watched for a sufficient length of time, nor have I made sufficient variations in my trials to be able to refer them to any distinct cause. A large bottle containing camphor, which has been deposited therein for more than a year under ordinary atmospheric pressures, has uniformly showed a crystallization towards the light.

For making these experiments properly, it is necessary to possess an air-pump receiver, ground so true, as to be able to main-

* Magazine of Popular Science, No. 23.

tain a vacuum for several hours, or even days. A less perfect jar may be made to answer, by fastening it down to the pump-plate with cap cement, it will, however, be liable to leak when the cement becomes warm by exposure to the sun. For many of these trials, a barometer tube is sufficient. Those who are provided with a good pump and jars, accompanied with their proper transfer plates, will have no difficulty whatever.

Upon the plate of the pump, or one of the transferers, place some camphor in a watch-glass, supported by a stand; over this place a bell jar, and exhaust until the difference of level of the ciphon gauge amounts to half an inch, or less; the further the rarefaction is pushed the better; remove the arrangement into the sunshine. In the course of five minutes, if the atmosphere be clear and the sun bright, small crystalline specks will be found on the side nearest to the sun, these continually increase in size, and at the end of two hours, many beautiful stellated crystals, from one-eigth to half an inch in diameter, will be found on that side, but on the other parts of the glass, only a few straggling ones here and there. Sometimes, as is the case in a result which I keep by me, the whole side next the sun is covered with a lamina of camphor, the other side containing none at all.*

ARSENICATED CANDLES.

CONSIDERABLE interest has been excited during the year, by the detection of arsenic in certain descriptions of candles, which were manufactured for superseding the more expensive wax-lights. The inquiry was commenced, by Mr. Everitt, before the Medico-Botanical Society, in experiments wherein he detected only four grains of the deleterious substance in a moderately-sized candle. Subsequently, Dr. Scott, of the Westminster Medical Society, stated, that it having been found by the various manufacturers that the larger the quantity of arsenic, the more alluring was the appearance of the candle, and the more brilliant the light, the poison had been gradually increased; and he (Dr. Scott) had now authority from two of the most extensive factors of these lights, to state, that one pound of arsenic to twenty-eight pounds of stearine were the proportions employed in their manufactory. Now, as these candles were not only much in use in private families, but had lately been introduced into some of the churches, and were likely to find their way into the theatres, he thought it would come within the province of the objects of the Society, to state its opinion respecting the safety of such a quantity of a poisonous mineral being burnt, and its vapour inhaled. The manufacturers to whom he had alluded, were anxious that the subject should be investigated; they had been compelled, in self-defence, to commit a fraud upon the public, by selling these fictitious articles, in consequence of the great

* Journal of the Franklin Institute; quoted in the Magazine of Popular Science, No. 22.

competition which had arisen from their manufacture by at least a dozen factors in London, each endeavouring to surpass his rivals by putting large quantities of arsenic into his candles.

On November 18, Mr. Everitt delivered before the Westminster Medical Society a lecture, in which he detailed the means used by him for detecting the presence of arsenious acid in fatty matter, and communicated the results of some researches he had made relative to this subject. The lecturer said, in commencing, that for the purpose of rendering his views and experiments clearer, he should divide the subject into three heads. The first was,

The Method of Detecting the Presence of Arsenious Acid in Fatty Matter.

Mr. Everitt said, that, after many trials, the details of which would not interest the Society, he was induced to recommend the following means for demonstrating the existence or non existence of arsenious acid in fatty matter, as being simple and easy of execution, and, at the same time, highly satisfactory in their results:—Let any quantity of the suspected matter, say one ounce, be taken and boiled with four or five times its weight of distilled water for one hour; then, let the water and the melted fat, while hot, be decanted into a clean porcelain basin, and allowed to cool without disturbance. When the fat has consolidated it can be removed in one piece from the surface of the water, which water, if the fat contained any arsenious acid, will hold it in solution, and it may be detected by the well-known agents employed for that purpose. Some liquid, which had been obtained in this way from candle fat, was divided into three portions, which were tested by the silver, copper, and sulphuretted hydrogen tests, which acted characteristically; and a piece of orpiment, previously obtained from the same source, was reduced to the state of metal in the usual way. Mr. Everitt, secondly, demonstrated

The Method adopted for Determining the Absolute Quantity of the Poison.

For this purpose, 300 grains of the suspected fat are to be boiled with 2,000 grains of distilled water for one hour, decanted, and allowed to cool as before, the cake of fat is again to be broken up and boiled with 1,000 grains more of fresh distilled water, cooled, and the cake again removed; to the two liquids thus obtained, when mixed and quite cold, add a few drops of hydrochloric acid, and pass a stream of sulphuretted hydrogen gas so as to precipitate all the arsenic as orpiment; it is safe to have an intermediate bottle containing a little water, between the flask generating the gas and the vessel containing the liquid to be operated on, so as to wash the gas, and prevent any accidental boiling over of the contents of the flask, disarranging the experiments. The solution, after standing some time, is then to be boiled, in order to drive off all excess of sulphuretted hydrogen, which tends to retain a small portion of orpiment in solution. After boiling, this will appear as a curdy bright yellow precipitate, floating in the clear colourless liquid. In order to estimate its weight accurately, a filter of the proper size is to be dried at 212°, and weighed out of contact of air (Mr. E. weighed it in a thin silver case), to prevent the hygroscopic power of the paper increasing its weight during the weighing process. This paper is then to be used for filtering the whole of the liquid, and collecting the orpiment; and after heating again

to 212°, till it is quite dry, which is to be known by successive weighings, as before, until the two last are alike,—the difference gives, of course, the quantity of precipitate; and as 124 grains of orpiment correspond with 100 of arsenious acid, it then becomes a matter of calculation. Two other precautions are, however, necessary to be taken; first, to see that the fluid which passes the filter retains no more arsenious acid, by passing into it a little more sulphuretted hydrogen; it should not become in the slightest degree yellow; next, to see if the collected precipitate be soluble in ammonia, which, if it is only orpiment, will be the case, but if, after passing the stream of sulphuretted hydrogen through the solution, it be allowed to remain long before it be boiled, to drive off the excess of gas, a little sulphur is liable to fall down with the orpiment, and increase its apparent weight; but as sulphur is not soluble in ammonia, and the orpiment is, the extent of this source of error can be estimated and allowed for. In order to know if this mode of treating the fat removed all trace of arsenious acid, a portion which did contain it, and which had been boiled twice with water, was melted in a shallow cup, and burnt by a floating wick, and the condensible products of the combustion collected and tested, which in no case gave any indication of the presence of arsenious acid. By these means Mr. E. had examined a great many samples of the so-called German wax, or stearine composition candles, and found the quantity of arsenious acid to vary from 10 to 18 grains in the pound weight of candles. Thirdly,

The Method of Determining in what Form the Arsenic leaves the Candles during their Burning.

In order to ascertain this point, the hot air, and all the products of combustion of a candle containing arsenious acid, were forced to pass up a glass bulb, and along the interior of a glass tube, eighteen inches long and one inch wide, which was kept cool by a bandage of cloth on the outside constantly moistened by water; by this contrivance a quantity of water was collected in the tube, tested, and found to contain arsenious acid, and a small quantity of a white sublimate was collected in that part of the condenser immediately over the candle, and which proved to be solid arsenious acid. In order that no smoke may mix with the products, the wick of the candle must be kept quite short, and all agitation of the air prevented by surrounding the flame with some sort of a screen.

Mr. E. stated it as his belief, that nearly all the arsenious acid thus found in fat, is in a state of simple mixture; for, on trying the quantity contained in different candles of the same parcel, different quantities were found; and that, on trying 300 grains from the top of the candle, and 300 grains from the bottom, one half more arsenious acid was found in the former than in the latter case, which he accounted for by supposing, that when the melted fat is poured into the mould (the bottom of the mould corresponding with the top of the candle), during the time it takes to cool, a tendency of the heavy ingredient to fall might cause this difference; and, further, by boiling some stearic acid with two per cent of finely powdered arsenious acid for two hours, and then allowing the fat to pass a filter kept hot, this fat was found to contain a mere trace of arsenious acid, not more than one grain to a pound; the rest remained on the filter. This fact is, to some extent, important, since, although the average quantity added to a given weight of fat may, perhaps, not be injurious, still, as its uniform diffusion through the mass depends solely on the care of the workmen, not on the solvent quality of the fat,

one parcel of candles may contain so large a proportion of this substance, as to make it dangerous to use them, a contingency which the use of this substance to any extent, however small, it is impossible to guard against, and ought to be a strong objection to its use as an article of consumption.

A Committee of the Westminster Medical Society was next appointed to investigate this interesting subject; and their Report is in substance as follows:—

The origin of the Stearine Candles is first related:—About twenty-five years since M. Chevreuil commenced investigating facts respecting common tallow, and after the unremitting labours of ten years, succeeded in discovering that it consisted of two distinct substances, which he denominated stearine and elaïne. The stearine, from its beautiful colour and consistence, was considered to be a very elegant material for the manufacture of candles, but it was found, on experiment, not eligible for that purpose. About six years since, however, candles made of stearine were first manufactured in Paris. The mode by which this was effected was, however, kept a profound secret. The stearine candles were afterwards introduced into this country; at first the manufacture was very limited, and the secret mode in which the stearine was made eligible for the formation of candles was confined to the knowledge of a few manufacturers. The secret however soon got hawked about, and was soon offered to candle makers for sale, and the manufacture of this description of candles soon became general, and as they were sold at a low price they were extensively used. Respectable houses of business, unable to compete with the "new lights," were compelled, in self-defence, to manufacture the same description of candles. The material which was employed for the purpose of fitting the stearine for use in this way was well known to the trade to be white arsenic; but the public were unaware of the fact until Mr. Everitt made the disclosure in a lecture given last summer before the *Medico-Botanical Society*. Dr. Scott had since introduced the subject into this Society, and hence the formation of the Committee. The Committee had instituted two series of experiments on various candles obtained from different shops, as it did not feel satisfied with the admissions made by parties concerned in the manufacture. These experiments were chemical and physiological; the former were mostly repeated before the members of the Society at a late meeting, by Mr. Everitt.

Mr. G. Bird had ascertained, that when these candles were burnt in such a manner as to allow the free mixture of the oxygen of the air with the flame, arsenious acid in vapour was given off. When the admission of air was interfered with, the black oxide of arsenic in vapour was the product; and when combustion was exceedingly low arsenuretted hydrogen was evolved. The Committee had also experimented with candles procured from club houses, private families, &c.; arsenious acid was detected in those candles, which were composed of stearine, while none was found present, in any instance, in the true wax lights, the true spermaceti, and the old-fashioned composition candles. The physiological experiments were made on various living animals, and were so conducted as to insure an accurate result. For this purpose four deal boxes were made, two of them marked A and B, measuring three feet by two; the others marked C and D, two feet by two, and both sets of them three feet deep. Into

one of each of these sized boxes two or three arsenical candles were kept burning; in the others candles which were known to be free from arsenic. The temperature of the interior was regulated by several holes made near the top and bottom of these boxes, and indicated by a thermometer placed inside, the temperature being kept as nearly as possible to that of summer heat. The tops of these boxes were movable, and there was a glass window on the door for observation. They were placed two feet and a half from the ground in a lofty and spacious apartment of Dr. Scott's house in the Strand. Into the two large boxes, A and B, the following animals were placed: In cage A, two linnets, two guinea-pigs, and one rabbit; in B, two guinea-pigs and one rabbit. In the box marked C, two bullfinches were placed; two similar birds were placed in D, all of them plentifully supplied with victuals and drink. The experiments with the larger boxes commenced on Monday, the 27th of Nov., at 10 A.M.; those in C and D at the same hour on the Tuesday. All the experiments ended on Saturday, the 2nd of December. The experiments were carried on from 10 A.M. to 10 P.M., daily. Observations were made during the whole of the period, and hourly remarks on facts placed upon paper. These records the Committee laid on the table of the Society, and merely now state the phenomena observed, leaving the members to draw their own conclusions. One of the birds in A, after being two hours in the box, became evidently affected, and remained more or less so during the day; at night, after the experiment had ceased, it recovered. The following morning, however, it died, after being again, for one hour, subjected to the vapour of the candles in the box, while its companion perished six or seven hours afterwards. Three linnets were then placed in the box with two burning arsenical candles; they seemed much indisposed during the day. The next day three candles were placed in this box, the birds showed many symptoms of uneasiness, and kept their beaks open; the next day, after being in the box three hours and a half, one of them died; the following day its companions also perished, though in the early part of the morning they seemed more lively than usual. The respiration of the little animals first became affected, the difficulty of breathing being indicated by constant gasping for breath; convulsions of the whole body succeeded, then great prostration of muscular power, intense thirst, evidenced by their drinking constantly and copiously of water, their last effort being an attempt to drink. They perished with their eyes closed, and with widely-extended beaks; the bullfinches were exposed at first to two candles, and afterwards to three, and perished with like symptoms at the end of forty-eight hours. Seven birds perished in the week; they drank four times more water than the birds in the boxes with pure lights; in addition to the other symptoms, the loss of all desire for food was mentioned, and diarrhœa, the matter voided being a greenish fluid. The birds in the boxes with pure lights were as gay at the end of the experiments as before they commenced, and ate and drank as usual; in fact, no evidence of anything extraordinary was observed in them. The larger animals in the boxes with the arsenical candles showed symptoms of uneasiness on the second day, their eyes became dull, they yawned frequently, they refused their usual victuals, and only took a very small quantity of green food; they drank a good deal of water towards the end of the experiments. The animals in the other boxes remained perfectly well. In order to ascertain what became of the arsenical vapour, on the third day a small dish of water was placed in the box, and a platinum dish sus-

pended over the flame of the candles. Arsenious acid was *detected in the water, and was found deposited on the sides of the dish in considerable quantity.*

Regarding the information which had been collected by the Committee, it had been ascertained that, according to the degree of combustion, arsenuretted hydrogen, black oxide, or white oxide of arsenic, in the state of vapour, were given off. The first of these was a rare product; the second was hardly likely to occur at the temperature at which the stearine candles burnt; the third was accordingly the most common. Two fatal examples of the ill effects of the first were mentioned; one of these occurred in the person of the celebrated chemist, Gehlen, the account of whose case is to be found in the "Journal de Chimie," for 1815. While occupied in the manufacture of arsenuretted hydrogen, he felt anxious to ascertain when the arsenic mixed with the hydrogen, in attempting to do which he inhaled a small portion of the vapour; the remedies employed to remove the ill effects which followed were unavailing, and he perished. The portion of the gas which escaped from the vessel must have been very small, as his coadjutor in the experiments stated that no odour was to be detected. The other case of death from the inhalation of this gas, the Committee had the authority of Mr. Phillips for mentioning, as having occurred recently at Bristol. Regarding the deleterious effect of arsenious acid vapours on the system, the Committee mentioned the case of Dr. Joseph Walt, who being desirous of trying this gas as a remedy in cases of ichthyosis, determined on submiting his own person to an experiment, for the purpose of ascertaining its probable effects upon the system. Accordingly, he placed six grains of arsenious acid in a chafing-dish, which he removed to some distance in the room; he was soon affected with shortness of breath, constriction across the chest, and other symptoms, which led to the conclusion that the arsenious acid vapour was poisonous. His friend repeated the experiment afterwards with similar and even more severe results. Dr. Scott, during the time he was superintending the experiments on the animals, found his eyes much affected, and this he attributed to the vapour arising from the arsenical candles; for, after the removal of the apparatus for carrying on the experiments, he did not experience any further annoyance of the kind.

Dr. Merat, in the "Dictionnaire de Matiere Medicale," stated that he had found flies exposed to the vapour of black arsenic perish. The effects of arsenic on the miners in Saxony and elsewhere, were also referred to, and also the bad results which take place from the use of this mineral in various manufactures. Arguing, then, from the facts which were presented, and from numerous cases resulting from the use of arsenic, recorded by medical men, the symptoms in which were similar to those observed by the Committee, would it be too much to assume that the extensive use of these candles in clubhouses, churches, theatres, &c. might be possibly injurious? Take, for instance, the supposition that Drury Lane Theatre was lighted with the arsenical candles,—about 152 candles were required for the several chandeliers in the house,—there would then be about 608 grains of arsenious acid passing off in the form of vapour during the time of the performance. Would not the effects be injurious to some persons in the assembly? The effects of arsenious acid applied to the skin might also be mentioned. M. Roux had recorded a case in which the arsenical paste being applied to a small ulcer

proved fatal. What, then, might be the effect of the gas applied to the mucous membrane of the bronchia?

A member of the Committee had entered into a correspondence with M. Chevreuil, and Dr. Pariset, Secretary to the Royal Academy of Medicine, in Paris; the replies given by these gentlemen were important, and were also laid before the Society. M. Chevreuil says, that it is unnecessary to mix arsenic with stearine, for the purpose of forming a candle, and is glad that the subject has been taken up in the manner it has. In the reply of the Prefect of Police of Paris, who was also written to, that functionary stated that when it was ascertained that arsenious acid was present in some candles which were manufactured in that capital, an inquiry was instituted into the subject. The Committee appointed for this purpose, consisting of many distinguished men, stated that they had found arsenious acid in the candles; they had considered, from experiments they had made, that the vapours of the gas were dangerous to the animal economy, and that the use of the candles should be prohibited by government. All the candles containing arsenic were accordingly confiscated, and the future manufacture of them prohibited. The authorities in Prussia had also forbidden the use of orpiment, which was employed for the purpose of colouring wax candles.

The Committee had also to offer some practical remarks on the subject. The candles in question went by a variety of names, such as "German wax-lights,"—"Venetian wax candles,"—"Stearine candles,"—"Imperial wax,"—"Moulded wax,"—"Tropical wax candles,"—and others; each manufacturer giving a different name to them. Arsenic was said to be required for the purpose of hardening these candles, but the Committee had learned that a small quantity of wax answered the same purpose. With regard to the characteristics of the candles containing arsenic, the following among others might be mentioned—the lowness of the price at which they were sold; this, however, was not always a valid test, inasmuch as one of the Committee had sent for a genuine wax candle, at the full price, but which was ascertained afterwards to be of stearine, and to contain the poison. These candles had always plaited wicks; when the surface of wax or spermaceti candles was rubbed with an ivory knife, it still remained bright and clear; this was not the case with the stearine candles, which were dull after such a proceeding, and no proceeds would restore the polish. The stearine candle had a spongy, porous appearance when snapped in two; the spermaceti presented the appearance of a lump of camphor, or a watery turnip, while the wax offered to the eye a series of concentric laminæ around the wick. When the stearine candle was extinguished, a garlic odour was perceptible from the wick. It was also found that a bell-glass, suspended over the steady flame of a stearine candle, had a white powder (the oxide of arsenic) deposited on its sides.

The conclusions at which the Committee arrive are, that the candles in question have been manufactured for the last two or three years in this country, and that the practice of making them is on the increase daily. The Committee conceive that the vapour given off from them during combustion is likely to be prejudicial. In closing their report, the Committee express their wish to be of service to the public in a matter of so much importance, in the absence of all medical police in this kingdom, the only country in Europe where the public health is so little regarded by the governing powers.

Dr. A. T. Thomson said, there was a test for these candles, which, after repeated and extended observations, he had found to be a correct one; the surface of the pure candles, around the burning wick, was always a level space, while in the stearine, arsenicated candles this space always formed a hollow cup, with a thin, transparent, ragged edge. Though on his being appointed on the Committee, he had some doubt respecting the injurious effects of the candles in question, the Report had fully satisfied him on the subject.

Mr. Barclay, a manufacturer of candles, stated that this test might be fallacious, other kinds of candles occasionally giving the same appearance during combustion.

Dr. A. T. Thomson believed the appearances to be peculiar to these candles; the ragged rim in other candles, all kinds of which he had burnt, was confined to one side of the flame, and this opposite to the current of air from a door, or other draught. The test, of course, was to be only looked upon as a collateral one, but many of the other tests being present, this one should also have its weight.*

It is gratifying to learn from a subsequent lecture upon the above subject, by Mr. Brande, that from the exertions of the Westminster Society, and the publicity given to their proceedings by the press, it is believed that at present there is not a single candle manufacturer who uses arsenic; it having been ascertained that a small quantity of magnesia, or fresh chalk acts similarly on the stearine, and to these less injurious substances the tallow-chandlers now resort.

CONGELATION OF MERCURY BY NATURAL COLD.

[Extract from a minute of observations on freezing Mercury in the open air, made at Gardiner, Maine, United States, January 28th and 29th, 1817, by Mr. Ed. Hall, jun.]

The whole of the day of the 28th was intensely cold. At two P.M. the thermometer hanging on the wall of a house stood at $-6°$. About sunset the wind subsided.

A tray of charcoal was placed upon the end of a wharf projecting into the Kennebeck, nearly a hundred yards from any building or other elevated object. On this was placed a thermometer in a blackened tin case, and two phials, each containing a small quantity of mercury, the lower half of each phial being blackened, and the phial a little raised from a horizontal position, so that the fluid might be within the blackened part. A similar phial of mercury was placed on the snow at a little distance: but as it underwent no change, no further notice was taken of it.

At 10 o'clock in the evening, the thermometer stood at $-29°$. The sky was perfectly serene and clear. At half-past 11, the thermometer had fallen to $-32°$. At half past 3 (the 29th), the thermometer was at $-38°$; the mercury in the phials of course still

* Abridged from the Lancet, Nos. 6, 9, 12 and 19, vol. i. 1837-8.

fluid. The atmosphere was remarkably transparent and perfectly calm. At half-past 6, the thermometer stood at $-40°$. It soon rose one degree while we were bending over to examine it; the mercury in the phials still fluid. I now poured out a small quantity of the mercury into an excavation in a piece of charcoal. At a quarter before 7, the thermometer was again at $-40°$; the mercury in the phials still fluid: but that on the charcoal was partially congealed. As I examined it with a slender stick, it exhibited the appearance of a soft solid, separating into parts without running into globules; and the fragments were rough, and evidently crystalline. These appearances, however, continued only a short time; but while I was examining it, being of course necessarily bent over it, the whole soon returned to a perfectly fluid state. At 7 o'clock, the thermometer was still as before at $-40°$. The mercury in the phials was unchanged. That on the piece of charcoal exhibited the same appearances as at the late observation, only in a less marked degree, and it sooner became fluid. Soon after this the sun rose, and of course the attempt was discontinued.

A few weeks later, having been supplied by the kindness of the late Mr. Vaughan with several excellent thermometers of Troughton's manufacture, I attempted to ascertain how much effect was attributable to the cooling of the surface by radiation, in a similar state of atmosphere: and on one occasion found a difference of 18° between a thermometer on charcoal on the ground, and another suspended freely in the air, 18 or 20 feet above it; one being 36°, the other 18° below zero. This was a clear night, and subsequently, when clouds appeared, the difference diminished, until at the commencement of snow, the two instruments agreed.—*Silliman's Journ.**

CHEMICAL ACTION OF THE SOLAR RAYS THROUGH FLUID PRISMS.

PROF. HESSLER, of Gratz, has found that the action of the solar spectrum, on paper which had been moistened with a solution of gum, and sprinkled with chloride of silver, varied with the nature of the prism. The action differed both in the extent and rapidity of its effect, and also in the point of the spectrum where it attained its maximum. It was nearly instantaneous with a prism of water or spirits of wine; occurred in the course of twelve or thirteen minutes with the oils of turpentine and cassia; in two minutes and three seconds with flint glass, and one minute and five seconds with crown-glass. The maximum chemical effect with spirits of wine, was obtained in the violet near the blue; with water, in the violet; with oil of cassia, twenty-three lines outside of the violet.†

* Quoted in the Magazine of Popular Science, No. 13.

† Magazine of Popular Science, No. 13.

EFFECTS OF ELECTRICITY BY CONTACT.

THE following is a summary communicated by Hr. von Humboldt, of the results to which Hr. Karsten of Berlin has been led by his recent investigations:

1. Metals, and probably all solid bodies, become positively electrified when immersed in fluids; the fluids are negative.

2. A solid, partially immersed in a fluid, acquires electric polarity; the part not immersed being negative, and the other positive.

3. Solid bodies differ greatly in their electro-motive power in regard to the same fluid, and this difference is the true cause of the electric, chemical, and magnetic action in the galvanic circuit.

4. If two solid electro-motors, of different electro-motive power, are immersed in the same fluid without being in contact with each other, the weaker electro-motor receives a polarity opposite to that of the stronger, and becomes consequently negatively electric.

5. The part of the weaker electro-motor not immersed, exhibits opposite electricity to that which is immersed, that is to say, it is positive.

6. The electro-motive action of a fluid depends on the property of its being reduced, by two solid electro-motors of dissimilar power, to such a state, that the solid electro-motors receive from it opposite electricities. In general, all fluids which are bad conductors of electricity, possess this property, but not those which are good conductors (mercury, metals in fusion, &c.) nor those which have no conducting power (oils, &c.) The intensity, however, of the electro-motive power of the fluids does not depend on the more or less perfect conductability only, but on other relations not fully known at present.

7. The electro-motive effects of two metals which form a closed circuit in the same fluid, depend on the continual excitement and neutralization of opposite electricities in the fluid. They are generated by the electro-motive action of the two electro-motors on the fluid; are augmented by the action of the stronger on the weaker; and are accelerated by the close contact of two solid electro-motors, when these are good conductors.

8. The chemical changes in the fluid, it is true, have a relation with the neutralization of the two electricities produced by the solid elements of the circuit, but these chemical changes, and the neutralization have not the mutual relation of cause and effect.

9. In the system of circuits composing the voltaic pile, the opposite electricities are completely neutralized by the solid elements of each circuit, that is, by the pairs of plates, and there is no electric current from one to the other.*

NEW COMPOUND OF HYDROGEN AND CARBON.

By W. Maugham, Esq., Lecturer on Chemistry.

I HAVE ascertained that a compound of carbon and hydrogen, not previously noticed, certainly exists; this compound consists of 1 atom of hydrogen = 1, and 1 atom of carbon = 6, so that its atomic weight is 7; and it therefore differs in composition from all other compounds of these two bodies already known. I propose to call it protohydruret, or protohydroguret of carbon. No-

* Magazine of Popular Science, No. 13.

thing is, perhaps, more difficult to remember, than the various names which have been given from time to time, to the previously known compounds of carbon and hydrogen, and these names I suspect will now require to be changed. I will give an early account of the properties, as well as the mode of preparing the new compound in question. I may observe, *en passant*, that the new substance differs entirely from olefiant gas, which is composed of double the quantities of carbon and hydrogen above enumerated, and consequently having 14 as its atomic weight.*

ON THERMO-ELECTRICITY.

By Mr. Francis Watkins.

THAT species of electricity developed by the influence of temperature first observed and made known to us by M. Seebeck, in communications to the Academy of Berlin, in the years 1821 and 1822, has latterly attracted increased attention in this country.

Professor Wheatstone informs us that Cav. Antinori obtained the spark from a thermo-electric pile of Noboli's construction, consisting of twenty-five elements, by employing an electro-dynamic helix and a temporary magnet; while Professor Wheatstone employed a thermo-electric pile of thirty-three elements of bismuth and antimony, formed into a cylindrical bundle three quarters of an inch in diameter, and one and one-fifth in length: the poles of this pile were connected by means of two thick wires, with a spiral of copper ribbon fifty feet in length and one and a half inch broad, the coils being well insulated by brown paper and silk.

We gather from these observations that Cav. Antinori employed an elongated coil as his electro-dynamic helix with temporary magnets for eliciting the spark, while Professor Wheatstone very judiciously resorted to the flat copper ribbon coil, contrived and recommended for developing electricity of feeble, intensity by Professor Joseph Henry, of New Jersey College, Princeton.

Cav. Antinori gives different lengths of his coils, and I presume in all cases that he had the advantage of the influence of temporary magnets, for I have experimented with short and slender coils surrounding different metals, wood, &c., and failed entirely in obtaining sparks under these conditions. When the same coils enveloped soft iron, then I got a spark, even a feeble one, from a coil the wire of which was only seven feet long, and 1-40th of an inch in diameter.

With Professor Henry's flat coil I always show larger sparks than with an elongated wire coil and large temporary magnet, and the snapping noise of the spark is certainly more discernible. Hence I feel warranted in advising those who desire to show the

* Magazine of Popular Science, No. 15.

thermo-electric spark in its fullest effect to use the flat ribbon coil of Professor Henry, in preference to the elongated wire coil and temporary magnet, at the same time permit me to add that those who possess a fair-sized electro-magnet can exhibit the spark of a thermo-pile with tolerable efficiency.

My first attempt to repeat Professor Wheatstone's experiments was with a very small and slender thermo-pile of thirty pairs of elements three inches long, and a Henry's coil, and I fully succeeded in eliciting the spark. A few days afterwards in an interview I had with the Professor he was so kind as to inform me that a thermo-electric pile of one inch square plates in his possession had afforded him sparks of an increased size to those obtained from the small pile described in his communication to you. Hence I adopted the suggestion of employing large metallic elements.

I have recently made many experiments with thermo-piles of various-sized and different-formed metallic elements, and different numbers of alternations, and find that the powers exerted by the metallic elements of a pile are referable to the same law which governs the developement of electricity derived from other sources of excitation, namely, that quantity is increased by mass.

The spark has hitherto been obtained from the surface of mercury, a metal at all times to be avoided in an apparatus in which metals like antimony and bismuth joined together by soft solder form a part. I arrange one of my extremities of the pile of strong sheet copper, cut like a comb, and covered with soft solder, (the latter is a plan, I believe first suggested by Dr. Hare, to obviate the trouble of amalgamating at every experiment), and when the movable extremity of my Henry's coil is passed over the comb, and the thermo-electric pile in action, splendid sparks are seen every time the moving part of the coil breaks the circuit by leaving a tooth of the comb. I have used stellar-formed wheels, vibrating pendulums, &c., &c., to break contact, and all give beautiful sparks and shocks when desired. When a small steel file forms the moving part, splendid scintillations are noticed, and to do away with amalgamation, soft solder, &c., I frequently employ an old plan of silver against silver for making and breaking contact; the spark thus developed is vivid, and, as we might expect, of a beautiful green hue; but it must be confessed that no sparks are so brilliant as those from the surface of mercury, for we can seldom obtain other metallic surfaces equally clean.

I desire here to record what I believe to be novel, that on the 27th of last June, with a thermo-electric pile, consisting of thirty pairs of bismuth and antimony, 1½ in. square, and ⅛ thick, with the radiation of red hot iron at one extremity and ice at the other extremity, a soft iron electro-magnet, under the inductive influence of the electricity thus generated, supported ninety-eight

pounds weight, the most powerful thermo-electric magnet I have heard of; but it must be observed that this is no maximum, for whoever employs a larger elementary battery will no doubt obtain greater effects, not only as regards inductive influence on soft iron, but all others in which the influence of temperature may be exerted.

There is an ample field for investigation open for those who have leisure on this subject. Who knows but hereafter electro-magnetism may be employed as a prime mover, and that a thermo-pile may be the exciting cause?

By adopting Professor Henry's method of giving the shock with his flat ribbon coil, from a single pair of voltaic plates, I have succeeded in obtaining in a marked and decided manner the physiological effects on the tongue, with the thermo-pile of thirty pairs of elements.

All that now need be said on that head is that I have thermo-electric piles varying from fifteen to thirty pairs of metallic elements, which give brilliant sparks by simply pouring hot water on one end, while the other end is at the temperature of the atmosphere. Again, sparks are exhibited by the same piles when the temperature is reduced at one end by the aid of ice, and the other end at the temperature of the surrounding air.

Of course, as has been noticed before, the effects will be greatly enhanced by still greater difference of temperature being produced at the opposite end of the pile.*

ANALYSIS OF SILK.

M. Mulder of Rotterdam remarks, that the only analysis of raw silk which we possess is that by Roard, inserted in the 65th volume of the *Annales de Chimie*, which, according to the present state of science, is incomplete and unsatisfactory.

To analyze silk M. Mulder subjected some yellow raw silk from Naples, and white raw silk from Amasieh in the Levant, to the successive operation of boiling water, absolute alcohol, and acetic acid, and he examined each of these solutions for the substances which they might contain.

The cold water dissolved a portion of the colouring matter of the yellow silk; the solution contained gelatine and albumen, as well as some cerine; in the alcohol there were colouring matter, resin, and a solid fatty matter. The æther dissolved only a certain quantity of colouring matter and resin which had been partly taken up by the alcohol. As to the acetic acid, the substance which it dissolved had all the appearance of albumen. The residue insoluble in this acid M. Mulder considered as the pure filamentous part of the silk. The residue obtained by the evaporation of the water, mixed with a little alcohol, then with æther, gave a little cerine. Both silks when distilled with dilute

* Abridged from the Philosophical Magazine, No. 67.

sulphuric acid, yielded an acid liquor, to which the author gave the name of bombic acid, already employed by some authors.

The quantities of the several substances obtained from each kind of silk were as under:

	Yellow Silk.	*White Silk.*
Filamentous matter	53·37	54·04
Gelatine....................	20·66	19·08
Albumen	24·43	25·47
Cerine	1·39	1·11
Colouring matter	0·05	
Resinous and fatty matter	0·10	0·30
	100·00	100·00*

VEGETATION IN A SOLUTION OF ARSENIC.

M. GILGENKRANTZ has seen a plant of the genus *Leptomitas*, or *Hygrocrocis*, form in a solution of arsenic. This observation, communicated by M. Bory St. Vincent, proves that arsenic, a substance so very poisonous, and supposed to be destructive to all organized bodies, is however favourable to the vegetation of some plants. M. Bory St. Vincent mentioned on this occasion that M. Dutrochet had observed about ten years ago the developement of a similar plant in a solution of acetate of lead.*

EXPERIMENTS MADE DURING A VOYAGE, AND AT BERMUDA, ON THE CARBONIC ACID IN THE ATMOSPHERE.

By Lieut.-Col. Emmett.

NOTES ON CARBONIC ACID IN THE ATMOSPHERE IN A VOYAGE TO BERMUDA.

1836, April 28.	Lat.	46°	0′	Long.	14°	51′
29.		44	–	——	18	21
May 1.	—	42	58	——	23	8
3.	—	42	9	——	27	55
11.	—	39	39	——	37	4
13.	—	39	8	——	38	
25.	—	30	53	——	61	

Carbonic acid found in all these trials made. Lime-water was the test. The quantity apparently fluctuated, the film forming at times more rapidly than at other times; most, *apparently*, on the 29th of April and the 1st of May.

Experiments made at Bermuda, per quantity.

Experiment 1. Sept. 25th. A glass receiver of 3,920 cubic inches, = 15·5 gallons, was taken to the north side of the island beyond any building. Wind north; day fine; thermometer 79°. Into this, after well washing with rain water and collecting the air, were put 1,500 grain

* Journal de Chimie Médicale; quoted in the Philosophical Magazine, No. 61.

* Journal de Pharmacie; Ibid.

measures of lime-water. The receiver was then well closed with a cork, and set aside.

Sept. 24, 4½ P.M.; therm. 82°. Some of the lime water used was tested; 1,500 lime-water taking 410 test sulphuric acid, the liquid would be 1·009 test. It took 330 to saturate the remaining lime-water; consequently left 80 for the carbonic acid in the air.*

Experiment 2. 25th of Sept. Receiver and acid as before, but the lime-waters but 210 for neutralization. Wind strong from S.W.; thermometer 80°.

Sept. 28th. The lime-waters from the receivers took 120 grain measures for neutralization, leaving 90 for carbonic acid gas; a very nearly similar result as before.

Experiment 3. October 2nd, at 5 P.M.; wind S.W. at the cessation of a heavy gale, with much rain; therm. 78°, barom. 30·00.

Receiver and acid as before. Lime-water required 390 measures for neutralization. Tested that in receivers at 5 P.M. of the 8th inst.; therm. 75°. This required 210 measures of the acid for neutralization, leaving 180 for carbonic acid, being double that before, or about 1 in 3,920.

Experiment 4. Oct. 11th, 4½ P.M. Collected air as before. There had been much rain during the day, but it was fine and calm after 3 P.M. Therm. 77°½. In this case the lime-water took 375 measures for neutralization.

Tested that in the receivers on the 18th; therm. 75°. The 1,500 grains in the receiver required 280 grains for neutralization, leaving 95 for carbonic acid gas.

In the experiments, 1, 2, and 4, the gas is consequently about 1 in 8,000; and in the 3rd, 2 parts in ,000. In the 3rd, the receiver was out during the rain, but so placed as to prevent its entrance. The air in 2 and 4 had traversed the small island of St. David's, distant perhaps 1¼ of a mile, thinly inhabited, and thence the inlet of the sea, St. George's Harbour.

The acid was pure, brought out with me for particular experiments.

Looking to the general result, and in No. 3 the quantity being *double*, inaccuracy of observation of the measures might possibly have led to the differences.

[Probably, the whole terraqueous globe is enveloped with the same atmosphere, as is the case in azotic and oxygenous gases. The reason why the carbonic acid is not so obvious, is its extreme minuteness. The whole quantity is not more than 1·000th part of the mass, or 1·1,500th part of the volume of the atmosphere. I have examined the air in a hothouse in July, with the air pent up during the night, and open in the usual manner during the day, and the whole quantity is the same as the carbonic acid in the atmosphere, neither more nor less.]†

* The receiver was not long enough exposed: my bottle was two gallons; it was exposed three or four days, and agitated to exhaust the air. Consequently ten times as much would probably be required by ten times the size of the bottle.

† Philosophical Magazine, No. 67.

ON A PERMANENT SOAP-BUBBLE, ILLUSTRATING THE COLOURS OF THIN PLATES.

By Joseph Reade, M.D.

No subject in natural philosophy has more engaged the attention of the learned than the discovery of a permanent soap-bubble. Mr. Boyle, Dr. Hook, and Sir Isaac Newton were among the first, Dr. Herschel and Sir David Brewster among the last experimenters. After such characters it may appear presumptuous to enter the lists unassisted by novelty of experiment; I therefore rest my claims principally on that ground, and hope in this paper that the reader may find that interesting subject simplified. The first account of the colours produced by thin plates is to be found in Mr. Boyle's works: "To show the chemist that colours may be made to appear or vanish, when there is no accession or change either of the sulphureous, the saline, or the mercurial principles of bodies, he says that all chemical essential oils, as also good spirits of wine, by shaking till they rise in bubbles, appear of various colours, which immediately vanish when the bubbles burst, so that a colourless liquor may be immediately made to exhibit a variety of colours and lose them in a moment without any change in its essential principles: he then mentions the colours that appear in soap-bubbles, and also in turpentine. He sometimes got glass blown so *thin* as to exhibit similar colours." Here we may remark, that although Mr. Boyle did not advance any theory from these experiments, yet it is evident that he connected the production of colours with the thinness of the substance, as appears from his endeavours to blow glass sufficiently thin. This suggestion in all probability afterwards gave the idea to Dr. Hooke, and finally to Sir Isaac Newton, who has the merit of clothing Hooke's suggestion in a mathematical dress, beautiful and interesting in the extreme.

Dr. Hooke was the next to investigate this subject; at a meeting of the Royal Society, 7th March, 1672, he promised to exhibit at their next meeting something which had neither reflection nor refraction, and yet was diaphanous; he then produced a bubble of soap and water. It was no wonder that so curious an experiment should excite the interest of one of the most learned, liberal and scientific societies in Europe; they requested him to bring an account of it in writing at their next meeting. "By means of a glass pipe he blew several small bubbles out of a mixture of soap and water, when it was observable that at first they appeared white and clear, but that after some time the film growing thinner, there appeared upon it all the colours of the rainbow, first a pale yellow, then orange, red, purple, blue, green, with the same series of colours repeated." Sir Isaac Newton's experiments as exhibited in his Optics are so well known, that I shall not enumerate them in this paper, merely remarking that his bubble was so evanescent

that it burst before he had time to make an accurate examination. Melville of Edinburgh thought to make a permanent soap film by means of freezing. This was impossible. It occurred to me that by taking off the atmospheric pressure 112 pounds to every square inch, I might accomplish my purpose; I therefore made the following experiment.

'*Exp.*—Having put two ounces of distilled water into an eight-ounce phial, and having added about the size of a large pea of Castile soap, I placed the bottle in a saucepan of boiling water on the fire; the bottle was speedily filled with a dense volume of vapour, which expelled all the air. I now corked it, and after cooling, and thus condensing the vapour, had perhaps as perfect a vacuum as could be formed, even by the best air-pump.* I now held the bottle laterally between my hands, and by means of a circular and brisk motion formed a circular film, on which by resting the bottle on an inclined plane, were formed after a short time all the parallel bands or series of colours in the following order: 1. a white or silvery segment at top; 2. a snuff-coloured brown inclining at bottom to a deep red; 3. blue; 4. yellow; 5. red; 6. blue; 7. green; 8. red; 9. green; 10. red; 11. green.

After some time a black segment was seen to form at the top of the white and continually to increase in size. After a few minutes the parallel bands increased in breadth, and running into one another only three or four distinct bands were seen. Nothing can exceed the beauty of these colours, equal to those of the rainbow, or the plumage of the tropics; whilst writing this description I have these bands in a bottle before me, feasting my eyes on their beauty. In a few minutes more this black segment or aqueous film occupies, perhaps, half the circular film, and the lower half becomes white tinged with orange.

If we now incline the bottle towards the experimenter's breast, the saponaceous atoms producing these colours are seen to float in the region of the black or aqueous: when placed again on the inclined plane they fall to the bottom of the films. In some time more the entire film becomes black, and all the colours disappear.

Having now placed the bottle in a basin of boiling water the evaporation was increased, and the black film soon became clothed with saponaceous atoms, which being variously condensed produced all the colours of the clouds when the sun is setting on a summer's evening. On again placing the bottle on the inclined plane, the parallel bands were again formed by the attraction of cohesion, and the colours afterwards gave place to the black film. I held the bottle laterally between my hands, and by means of a circular motion washed it, and thus clothed it with saponaceous atoms, which went through the same process on placing the bottle on the inclined plane. By means of washing the film every morning, I preserved it for more than three weeks. This simple experiment opens a wide field of investigation to the natural philosopher, and enables him at his leisure to examine the interesting phenomena of these colours.

[Since the date of the above paper, Dr. Reade on the 14th of September exhibited the mode of preparing a permanent soap-

* This vacuum, we apprehend, may be vitiated by the entrance of atmospheric air through the cork, indicating the necessity of covering it with cement.—Edit. Phil. Mag.

bubble before the Section of Physics at the meeting of the British Association at Liverpool.]*

SILICEOUS AND CALCAREOUS PRODUCTS OBTAINED BY MEANS OF SLOW ACTIONS.

Report by MM. Gay-Lussac and Becquerel, on a Note of M. Cagniard-Latour.

M. Cagniard-Latour states that by the means of several processes which he has devised, and which are dependent upon slow action, he has succeeded in forming various substances analogous to those which are found in nature. The following are some of the results which he has obtained.

"*First Experiment.*—Some lamp-black was treated with hot concentrated nitric acid; the liquor after having been poured off was exposed under a bell-glass for several months to the action of solar light; in proportion as the acid diminished, water or acid was added; by degrees siliceous concretions formed, some of which inclined to the pyramidal form. Analysis indicated two per cent. of carbon; these concretions submitted in a platina crucible to the action of caustic potash, heated by the flame of an alcohol-lamp, diminished in size; their hardness is sufficient to scratch rock crystal.*

"*Second Experiment.*—Some of the bog iron, (*fer limoneux*,) of Berry was taken; after having reduced it to a very fine powder, it was treated with hydrochloric acid; the solution was diluted with water and was filtered; it was next put into a large retort, and a glass capsule containing a piece of white marble was then suspended in it. The marble was gradually attacked, carbonic acid gas was disengaged; oxide of iron was deposited, and crystals several millimetres in length having the form and principal properties of felspar with a calcareous base.

"*Third Experiment.*—Milk of lime, (*lait de chaux*,) was poured into a solution of perchloride of iron, to which had been added a brown infusion of roasted corn. The precipitate having been well washed in water, then mixed with this liquid, the mixture was heated in a kind of Papin's digester until the interior pressure amounted to eleven atmospheres; siliceous grains were precipitated produced from the milk of lime. The matter was then taken and redissolved anew in hydrochloric acid; the solution having been filtered, it was again filtered through chalk of Meudon, which had been passed through very fine cambric, by means of water, to separate the grains of quartz from it. Oxide of iron was deposited in the chalk. When the filtration was difficult, the liquor was acidulated. At the end of fifteen days the Meudon whitening was again strained through the cambric, and the part which had not passed was treated with hydrochloric acid; small opalescent siliceous concretions were obtained, of which several have the form of crowns and are split from the centre to the circumference: they are not fusible with the blow-pipe and scratch glass; those which were coloured being moderately heated, acquired a smoky tint in consequence of the organic matter which they contain.

"*Fourth Experiment.*—125 grammes of powdered Meudon whitening

* Philosophical Magazine, No. 68.

were put into a glass tube about two inches in diameter, and four feet and a half in height; the lower part of the tube was then closed with a piece of linen rag intended to serve as a filter. Afterwards water was put into the tube, and the whitening was shaken so as to mix it well. After having completely filled up the tube with this water, some water very weakly acidulated with hydro-chloric acid was prepared; and in proportion as the water first put into the tube filtered away through the whitening and the linen upon which it rested, acidulated water was poured into the tube. The filtered water deposited by degrees in a bottle in which it was received, crystalline grains of carbonate of lime; and at the same time the linen serving as a filter, became covered over a great part of its exterior surface with a crust which, examined with a magnifying glass, had the appearance of saccharoidal marble. The experiment lasted about three months. The quantity of whitening of Meudon which was dissolved during the time that the filtration continued was about 75 grammes, that is to say, a little more than the half of all the whitening which had at first been put into the tube." *

NEW CARBURETS OF HYDROGEN, RETINNAPTHE, RETINGLE, RETINOLE, AND METANAPHTALENE.

MM. Pelletier and Walter have examined the products obtained during the conversion of resin into gas for gas lights; the results are stated to be:

1st. The instant the resin falls into the red-hot cylinder there are formed with the gas a certain number of extremely hydrogenated compounds which have been separated by chemical analysis.

2nd. Among these substances there occur three new carburets of hydrogen, to which the author has given the names of *rétinnapthe*, *rétingle*, and *rétinole*; these are all liquid: there are two solid carburets of hydrogen, *napthalene*, already known, and *métanapthalene* a new compound.

3rd. Rétinapthe is a very light and volatile fluid; its composition, determined by the density of its vapour, may be represented by C^{28} H^{16}. This product, M. Pelletier observes, is at least isomeric with one carburetted hydrogen, which is still hypothetical, but which appears to play a great part in the benzoic compounds, if indeed it be not itself this carburetted hydrogen; it gives rise to a series of new compounds.

4th. Rétingle is a new sesquicarburet of hydrogen, which may be represented by the formula C^{36}, H^{34}, H^{24} [?]; it is susceptible of conversion by the action of chlorine, bromine, and nitric acid, into compounds which exhibit a series of new combinations.

5th. Rétinole is a new bicarburet of hydrogen, the formula of which is C^{64} H^{32}; it differs from the bicarburetted hydrogen of Faraday C^{24} H^{12}, both in its constitution and its chemical properties.

6th. Métanaphtalene is a new substance, which differs from naphtalene in its properties, but isomeric with its composition. It is remarkable for its splendour and beauty, its chemical indifference, in which property it resembles paraffine, from which it differs totally in its properties and composition.

* Comptes Rendus, No. 25; quoted in the Philosophical Magazine, No. 68.

The substances whose properties and composition have now been briefly stated, result from the sudden application of a red heat to resin. M. Pelletier states, that in a second memoir he will examine the properties of the products obtained from resin at lower temperatures.*

ON THE THERMO-ELECTRIC SPARK, AS OBTAINED FROM A SINGLE PAIR OF METALLIC ELEMENTS.

By Mr. Francis Watkins.

THE following fact in thermo-electricity, the author believes, has not been noticed in print in this or any other country.

With a pair of metallic elements, consisting of one bismuth and one antimony, weighing each five grains and measuring 0·5 of an inch long and 0·12 diameter, when their extremities were unequally heated, I have obtained, with a Henry's flat ribbon coil, a very perceptible and brilliant spark.

I have had the pleasure of showing the experiment to MM. De la Rive, Plateau, and Netschayef, and I need not add that these distinguished philosophers were much delighted on seeing the *thermo*-electrical light developed by a single pair of metallic elements.

Now I have pen in hand permit me to state that with thermo-piles I actuate most of the apparatus usually employed for illustrating electro-magnetic phenomena, so that the public teacher may now show by the same apparatus the several rotations, &c. with thermo-electricity, as he does with voltaic electricity.†

ACTION OF COLD AIR IN MAINTAINING HEAT.

MR. R. PHILLIPS observes: "I believe it is not generally known that nail-makers are in the habit of supporting the heat of the iron, when hammering it into form on the anvil, by blowing a current of cold air upon it.

"An opportunity accidentally presenting itself sometime since near Birmingham, I asked a nail-maker to show me the operation, which he readily did, observing that to do it with the greater effect he would put an additional weight upon his bellows. He also mentioned that it was requisite to employ the iron at a very high temperature, or otherwise the cold air instead of maintaining and increasing the heat would quickly cool the iron. The efficacy of the current of air and the necessity of making the iron very hot when employing it, were rendered as perfectly evident as the use of bellows in increasing the combustion in a common fire." ‡

* L'Institute; quoted in the Philosophical Magazine, No. 68.
† Philosophical Magazine, No. 68.
‡ Philosophical Magazine, No. 68.

SPONTANEOUS COMBUSTION OF LINSEED OIL AFTER ITS BECOMING DRY.

THE heating of linseed oil when soaking into soft vegetable fibrous or porous matters, has been several times brought into public notice: but we have not observed this effect when the oil has become dry and hard.

A manufacturer at Plymouth had occasion, two or three years since, to grind some red lead in oil, and a cask of it was set aside till it had become hard, and consequently useless, which soon happens to that mixture, red lead being a rapid "dryer." Some months since, being annoyed at this cask lying about the warehouse, he ordered it to be knocked to pieces and the contents powdered, to see if anything could be made of it. This being done in the evening, and the powder put into a box, he was surprised in the morning by a smell of fire, and after searching the warehouse over, perceived smoke issuing from this box; water was thrown in, and when all was cold the contents were turned out. The bottom of the box was found charred, the matter next it brown and partly reduced, and so to about the centre of the mass, from whence it shaded off through chocolate colour to the surface, which retained its redness, but was clotted hard together like all the rest.

The same manufacturer has occasion for large quantities of oiled paper, which when quite dry and no longer adhesive to the touch, he has sometimes put together in piles, but has been obliged to separate them again on account of the heat generated, which has been such as to threaten ignition.*

PROCESS FOR INK DEVOID OF FREE ACID.

By R. Hare, M.D., Professor of Chemistry in the University of Pennsylvania.†

WRITING ink is usually constituted of the tanno-gallate of iron and a portion of sulphuric acid, which had existed in the copperas or sulphate of iron employed as one of its ingredients, the tanno-gallate being suspended and the acid dissolved in the water. This free acid is injurious to iron pens. Dr. Hare has observed that when an infusion of galls is kept over finery cinder till saturated, it forms a beautiful ink, in which of course there is no free acid.

This ink is rather more prone to precipitate than that made with sulphate of iron, and this propensity is not counteracted by the addition of gum arabic. But, on the other hand, it has the advantage of being easily suspended again by agitation, not

* Philosophical Magazine, No. 67.

† The above and three following notices have been communicated by the author.

forming any concrete matter insusceptible, like common ink grounds, of that distribution in water which is necessary to good ink. The tanno-gallate of iron when obtained from a filtered infusion of galls and finery cinder, as above described, on being evaporated to the consistency of thick molasses, gum arabic in due proportion having been previously added, forms a pigment which might, it is conceived, supersede Indian ink. When completely dried it glistens like jet with or without the gum.

This tanno gallate of iron only requires to be dried and ignited at a low red heat, in order to be converted into a pyrophorus. A few years ago Dr. Hare ascertained that, by a similar ignition in close vessels, cyano-ferrite of iron, the Prussian blue of commerce, gave a pyrophorus. But as the pure cyano-ferrite of iron, resulting from the addition of the ferro-prussiate of potash, more properly the cyano-ferrite of potassium, to a ferruginous solution did not form a pyrophorus; he was led to believe that the presence of sulphate of alumine in the commercial Prussian blue was the source of the difference, probably by being converted into a sulphide of aluminium, or potassium.

The production of a pyrophorus from the tanno-gallate proves that iron and carbon, when in a state of minute division, are capable, by ignition in close vessels, of acquiring that property of spontaneous combustibility which entitles the body which possesses it to be called a pyrophorus.

In truth, these results are consistent with some facts mentioned by Berzelius, as having been ascertained by Mitcherlich, respecting the spontaneous combustibility of iron, reduced from the state of magnetic oxide to that of the pure metal in an extreme state of division. They are also consistent with the spontaneous combustibility of the residue resulting from the ignition of the oxalate of iron at a red heat.*

RAPID CONGELATION OF WATER BY MEANS OF HYDRIC, (SULPHURIC) ÆTHER AND CONCENTRATED SULPHURIC ACID, &c.

By R. Hare, M.D.

In freezing water by the vaporization of hydric, commonly called sulphuric, æther, there is much labour in pumping, and the ætherial vapour condensing in the pump, disqualifies it for nice experiments until cleansed. Dr. Hare finds that the interposition of sulphuric acid lessens the requisite labour, and protects the pump. By means of a globe or bottle with two tubulures, and a glass funnel with a cock, the acid being in the globe, the water in a retort, and the æther in the funnel, while the two former are exhausted, on allowing the æther to descend upon the water, the congelation of this liquid is instantaneous.

It has been ascertained by the same chemist, that a permanent

* Philosophical Magazine, No. 67.

self-regulating reservoir of chlorine may be made by means of the apparatus heretofore used by him for nitric oxide, substituting for the materials used in that case, manganese in lumps and concentrated muriatic acid.

In one case, Dr. Hare, doubting the purity of the gas, from some indications, among others the want of the usual degree of colour, in order to test it, exposed leaves of a thin metal called Dutch gold leaf, to a jet of this gas, as he had previously done repeatedly, without any ill consequence; to his astonishment an explosion took place, which burst the apparatus and produced a detonation as loud as if one of the explosive compounds of chlorine and oxygen had been generated. Yet the only agents employed were peroxide of manganese and chloro-hydric (muriatic) acid. It was the deficiency of intensity in the colour which led him to test it by means of the leaf metal. The colour of the protoxide is known to be of a deeper yellow than that of chlorine.*

SYNTHESIS OF AMMONIA.

By R. Hare, M.D.

UNDERSTANDING that the synthesis of ammonia had been effected by the reaction between nitric oxide and hydrogen promoted by the presence of platina sponge, Dr. Hare, having no knowledge of the process as performed in Europe, succeeded in the following manner in the attainment of that highly interesting result.

Two volumes of nitric oxide and five of hydrogen were introduced into a bell glass with a perforated neck furnished with a cap and cock. At the bottom of a tabulated glass retort, capable of holding about four ounce measures of water, a small heap of platina sponge was made. A leaden pipe communicating with the cock of the bell at one end, and at the other terminating in a copper or glass tube, having a bore about as large as a knitting-needle, was passed through the tubulure so that the orifice of the tube was nearly in contact with the metallic heap. The pipe was made to form an air-tight juncture where it entered the tubulure, and the beak of the retort was recurved so as to be beneath the surface of some water in a wine-glass. The bell being depressed below the surface of the water in the pneumatic cistern, the cock was opened so as to allow the gaseous mixture to enter the retort and displace the atmospheric air. As soon as this was known to have taken place, by the disappearance of the red fumes resulting from the reaction of the nitric oxide and atmospheric oxygen, the gas being still allowed to pass slowly in bubbles through the water in the wine-glass, an incandescent coal was held near the part of the retort supporting the sponge. The metal being thus heated became ignited, and fumes appeared in the cavity of the retort.

* Philosophical Magazine, No. 67.

An absorption of the water in the wine-glass followed, which was however immediately checked by a supply of gas from the bell sufficient to cause the bubbling to recommence and continue. Under these circumstances the water in the wine glass acquired the odour of ammonia, and gave with the copper the well known blue colour.

In a subsequent experiment a small lump of the sponge was secured in a coil of platina wire and fastened to the tube so as to receive the jet of the mixed gases.

Dr. Hare published the fact, some years since, that abestus soaked in a solution of chloride of platinum and ignited, would cause the inflammation of hydrogen with oxygen. He finds asbestus, similarly prepared, to produce the synthesis of ammonia, either when substituted for the sponge, in the experiment above described, or carried red hot from a fire and passed into a bell glass containing the mixture over mercury.

In fact a piece of charcoal soaked in a solution of chloride of platinum, (choroplantinic acid,) produced effects analogous to the platinated asbestus.

To produce platinated asbestus, it was found sufficient to dip it in liquid chloride of platinum, and then subject the mass to a red heat in a common fire.*

ROTATORY MULTIPLIER.

By R. Hare, M.D.

Dr. Hare has contrived a rotatory multiplier as follows:—

Just as the needle, in oscillating, reaches its appropriate position in the meridian, by means of two pins proceeding from it perpendicularly so as to enter two mercurial globules, it completes a circuit through the coil; one end of which terminates in one of the globules. The other end of the coil of the multiplier communicates with one pole of a galvanic pair, of which the other pole communicates with the other globule. The needle is thus subjected to an impulse which causes it to revolve until it receives another impulse by the same process repeated. Each revolution therefore causes an impulse which is productive of a succeeding revolution so long as the galvanic reaction is sustained.

The construction was subsequently improved by employing two coils of copper wire of equal length, separated by paper and varnish, one being wound over the other. They were so arranged that the needle receives two impulses in each revolution, one as above described, the other when its north pole points to the south. Again, two needles associated so as to form

* Philosophical Magazine, No. 67.

a cross are made to complete a circuit every fourth of a revolution, and thus to receive four impulses in one revolution.*

GASEOUS DIFFUSION.

The following experiment has recently been made in the laboratory of Prof. Draper, of Hampden Sidney College, Virginia, and communicated to us by him: it is a good illustration of the endosmosis of gases, and is well adapted for a class-room experiment.

Take a two-ounce phial with a wide mouth, and having made a solution of soap in water of the consistency of a viscid lather, dip one of the fingers into it, and pass it over the mouth of the phial; this will leave a thin *plane* film stretched across it. Place over the phial thus arranged a jar of protoxide of nitrogen, in the course of a few seconds the horizontality of the film will be disturbed; it will become convex, and at the end of a minute and a half or two minutes, it will form the greater part of a sphere two inches in diameter, the colours of which are brilliant.

The extreme rapidity with which gases pass through films of water, has afforded in the hands of the same chemist a good method of determining the condition of equilibrium and law of the transit of gases. A series of papers communicated during the past and present years to the American Journal of Medical Science, and Journal of the Franklin Institute, contain a developement of these laws. An illustration from these researches will give an idea of their result.

In an atmosphere containing 190 measures of nitrogen gas, a soap bubble was expanded containing 190 measures of protoxide of nitrogen. The bubble collapsed with great rapidity, and at the end of three minutes its contents were found to be 35 measures, the atmosphere around it being 341 measures. On analysis it was found that the constitution of the gas within and without the bubble was identical, one half being the protoxide and the other half being nitrogen.

By thus measuring and analyzing the contents of bubbles and the atmospheres around them, the general law of equilibrium was proved to be, that motion only ceased when the chemical composition on both sides of the barrier had become alike.†

ARTIFICIAL PRODUCTION OF RUBIES.

M. Gaudin has presented to the Academy of Sciences of Paris a note, in which he announces his having been able to produce rubies in considerable quantities, by a process of which he gives the following sketch.

* Philosophical Magazine, No. 67.
† Philosophical Magazine, No. 70.

In order to obtain these substances analogous to rubies, M. Gaudin uses a platinum blowpipe of a single piece, formed of two hollow concentric cylinders, communicating by one of the extremities, one with a reservoir of hydrogen, the other with a reservoir of oxygen; the two other extremities are pierced with convergent openings, so as to effect in a great degree the mixture of the gases.

It is well known that alumina is fusible with the oxygen and hydrogen blowpipe; but no one before M. Gaudin had endeavoured to melt this earth into globules several millimetres in size. Having submitted a piece of potash alum to the action of his blowpipe, he obtained a perfectly round and limpid globule. The platinum tube being perforated and melted at several places, he obtained after the cooling, instead of a limpid spheroid, an opake elongated globule, and covered internally with crystals, which may be referred to the cube or to the rhombohedron. These crystals scratch rock crystal, topaz, garnet, and spinelle; with regard to hardness, therefore, they agree with the ordinary ruby. They appear to be composed solely of alumina, the potash volatilizing at the high temperature to which the alum is submitted.

Having obtained an apparatus stronger than the one first used, he made an experiment with some ammoniacal alum mixed with from four to five thousandths of chromate of potash; the whole being previously calcined, he gave it the form of a spherical cup, in order to obtain a maximum effect, by directing the flame to the concave part. In a few moments the inner surface of this cup was covered with globules of a beautiful ruby-red colour, slightly translucid, and some of which exhibited the form and cleavage of the ruby.

M. Malaguti, who had occasion to analyze these globules, found them to be composed of 97 parts alumina, one of oxide of chrome, and two parts of silica and lime; which composition is analogous to that of the ruby.*

A NEW ORGANIC ACID.

M. Péligot has read to the Academy of Sciences some observations on cane sugar, and on a new acid derived from the action of alkalies on sugar of starch.

It is well known that there exist two distinct varieties of sugar; one of them is common sugar, extracted from the cane, beetroot, and the maple; the other occurs in grapes and diabetic urine, and is formed when starch, lignin, or sugar of milk is treated with dilute sulphuric acid. It is also known that, influenced by various circumstances, common sugar may be converted into sugar identical with that of starch.

* Comptes Rendus; quoted in the Philosophical Magazine, No. 70.

Among the differences which exist between the two kinds of sugar, one of the most prominent, (says M. Peligot), is in my opinion that which is observed when these bodies are put in contact with alkaline bases.

Common sugar, when added to potash, lime, or barytes, combines with these bases, and acts towards them the part of a true acid: by boiling a mixed solution of barytes and sugar, I obtained by direct action a crystallized compound of these two bodies; the analysis of saccharate of barytes, and other analogous salts, proves that the sugar does not undergo any particular modification: on decomposing the saccharates by weak acids, the sugar reappears with its usual properties.

The case is entirely different with sugar of starch; the alkalies effect an essential alteration in it. On putting lime or barytes into a solution of this sugar, even cold, I observed that after a certain time these bases had lost their alkaline properties, and were saturated with a new and very powerful acid, which is formed by simple contact with the sugar, and which immediately unites with the alkalies, and forms perfectly neutral salts. This acid may be still more readily obtained by putting dry sugar of starch, fused at 212°, in contact with crystallized hydrate of barytes. Vivid reaction takes place almost immediately; the mixture swells, the temperature rises very much, and in a few seconds the sugar is transformed into acid. The barytic salt is then dissolved in water, and the acid is precipitated by means of a solution of subacetate of lead, to be gradually added, in order first to separate a brown colouring matter which arises during the reaction, at least when operating in contact with the air. The last precipitate obtained is colourless, and contains the acid in the state of subsalt; it may then be separated by the usual means.

Besides this acid, another non-volatile body is produced, which possesses the property of immediately reducing, when cold, the salts of silver and of mercury.

The very easy formation of an acid, by the contact of sugar of starch or of grapes, with bases (M. Peligot observes), shows how proper it is to avoid the employment of too much lime in the purification of the beet-root juice; for although lime does not alter the sugar, it acts, when in excess, upon the sugar analogous to that of grapes, into which common sugar is easily converted by the influence of heat, acid, or fermentation. There are therefore two difficulties to be avoided; these may be apprehended at the same time,—the intervention of acids which decompose the sugar intended to be extracted, and the effects of the alkalies which act upon the sugar of starch resulting from this decomposition.*

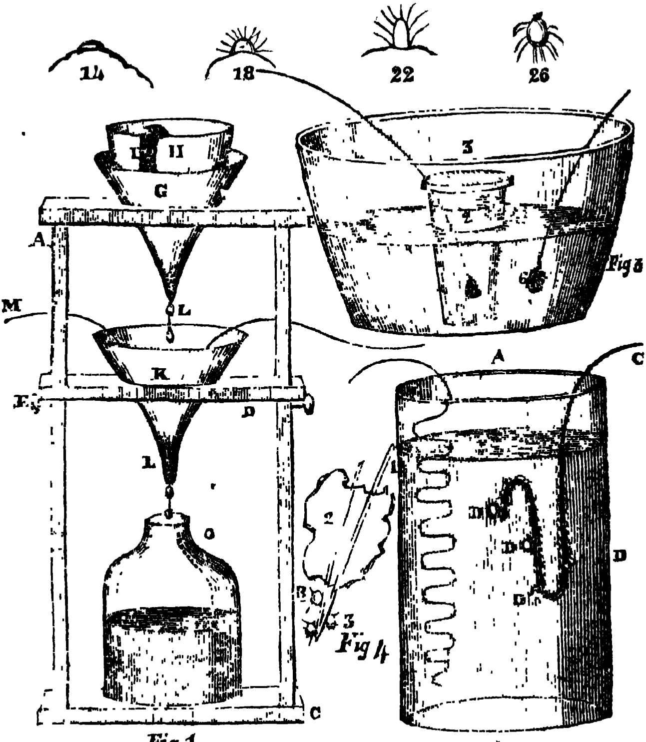
* L'Institute; quoted in the Philosophical Magazine, No. 70.

MR. CROSSE'S DISCOVERIES IN GALVANISM.

DURING the past year, Mr. Crosse has persevered in his very interesting experiments, the results of which he has communicated in letters to the Electrical Society, whence the following are extracts:—

I trust that the gentlemen who compose the Electrical Society will not imagine, because I have so long delayed answering their request, to furnish the Society through you, as its organ, with a full account of my electrical experiments, in which a certain insect made its unexpected appearance, that such delay has been occasioned by any desire of withholding what I have to state from the Society in particular, or the public at large. I am delighted to find that at last, late, though not the less called for, a body of scientific gentlemen have linked themselves together for the sake of exploring and making public those mysteries, which hitherto, under a variety of names, and ascribed to all causes but the true one, have eluded the grasp of men of research, and served to perplex, perhaps, rather than to afford sufficient data to theorize upon. It is true that much has been done in the course of a few years, and that which has been done only affords the strongest reasons for believing that vastly more remains to be done. It would be presumptuous in me to enumerate the services of a Davy, a Faraday, and many other great men at home; or a Volta and an Ampere, with a host of others abroad. These distinguished men have laid the foundations on which their successors ought to endeavour to erect a building worthy of the scale in which it has been commenced. Electricity is no longer the paltry confined science which it was once fancied to be, making its appearance only from the friction of glass or wax, employed in childish purposes, serving as a trick for the schoolboy, or a nostrum for the quack. But it is, even now, though in its infancy, proved to be most intimately connected with all operations in chemistry, with magnetism, with light and caloric; apparently a property belonging to all matter, perhaps ranging through all space, from sun to sun, from planet to planet, and not improbably the secondary cause of every change in the animal, mineral, vegetable, and gaseous systems. It is to determine whether this be, or not, the case, as far as human faculties can determine, to ascertain what rank in the tree of science electricity is to hold; to endeavour to find out to what useful purposes it might be applied, that I conceive is the object of your Society, and I shall at all times be ready and willing, as a member, to contribute my quota of information to its support, knowing well, that however little it might be, it will be as kindly received as it is humbly offered.

The following is a plain and correct account of the experiments alluded to:—In the course of my endeavours to form artificial minerals by a long-continued electric action on fluids holding in solution such substances as were necessary to my purpose, I had recourse to every variety of contrivance which I could think of, so that on the one hand, I might be enabled to keep up a never-failing electrical current of greater or less intensity, or quantity, or both, as the case seemed to require; and, on the other hand, that the solutions made use of should be exposed to the electric action in the manner best calculated to effect the object in view. Amongst other contrivances, I constructed a wooden frame (Fig. 1, A.) of about two feet in height, consisting of four legs (B), proceeding from a shelf (C.) a the bottom supporting another at the top (F.), and containing a third in



the middle (D.) Each of these shelves was about seven inches square. The upper one was pierced with an aperture, in which was fixed, a funnel of Wedgewood ware, within which rested a quart basin (H.) on a circular piece of mahogany placed within the funnel. When this basin was filled with a fluid, a strip of flannel (I.) wetted with the same, was suspended over the edge of the basin and inside the funnel (G.) which, acting as a syphon, conveyed the fluid out of the basin, through the funnel, in successive drops (L.) The middle shelf of the frame was likewise pierced with an aperture, in which was fixed a smaller funnel of glass (K.), which supported a piece of somewhat porous red oxide of iron from Vesuvius, immediately under the dropping of the upper funnel. This stone was kept constantly electrified by means of two platina wires on either side, of it, connected with the poles of a Voltaic battery of nineteen pairs of five-inch zinc and copper single plates, in two porcelain troughs, the cells of which were filled at first with water and 1·500 of hydrochloric acid, but afterwards with water alone. I may even state, that in all my subsequent experiments relative to these insects, I filled the

wells of the batteries employed with nothing but common water. The lower shelf merely supported a wide-mouthed bottle, to receive the drops as they fell from the second funnel. When the basin was nearly emptied, the fluid was poured back again from the bottle below into the basin above, without disturbing the position of the latter. It was by mere chance that I selected this volcanic substance, choosing it from its partial porosity; nor do I believe that it had the slightest effect in the production of the insects to be described. The fluid with which I filled the basin was made as follows:—I reduced a piece of black flint to power, having first exposed it to a red heat, and quenched it in water to make it friable. Of this powder I took two ounces, and mixed them intensely with six ounces of carbonate of potassa, exposed them to a strong heat for fifteen minutes in a black lead crucible in an air furnace, and then poured the fused compound on an iron plate, reduced it to powder whilst still warm, poured boiling water on it, and kept it boiling for some minutes in a sand bath. The greater part of the soluble glass thus fused was taken up by the water, together with a portion of alumina, from the crucible. I should have used one of silver, but had none sufficiently large. To a portion of silicate of potassa thus fused, I added some boiling water to dilute it, and then slowly added hydrochloric acid to supersaturation. A strange remark was made on this part of the experiment at the meeting of the British Association at Liverpool, it being then gravely stated, that it was impossible to add an acid to a silicate of potassa without precipitating the silica! This, of course, must be the case, unless the solution be diluted with water. My object in subjecting this fluid to a long-continued electric action through the intervention of a porous stone, was to form, if possible, crystals of silica at one of the poles of the battery, but I failed in accomplishing this by those means. On the fourteenth* day from the commencement of the experiment, I observed, through a lens, a few small whitish excrescences or nipples, projecting from about the middle of the electrified stone, and nearly under the dropping of the fluid above. On the eighteenth* day these projections enlarged, and seven or eight filaments, each of them longer than the excrescence from which it grew made their appearance on each of the nipples. On the twenty-second* day these appearances were more elevated and distinct, and on the twenty-sixth* day each figure assumed the form of a perfect insect, standing erect on a few bristles which formed its tail. Till this period I had no notion that these appearances were any other than an incipient internal formation; but it was not until the twenty-eighth day, when I plainly perceived these little creatures move their legs, that I felt any surprise, and I must own that, when this took place, I was not a little astonished. I endeavoured to detach, with the point of a needle, one or two of them from its position on the stone, but they immediately died, and I was obliged to wait patiently for a few days longer, when they separated themselves from the stone, and moved about at pleasure, although they had been for some time after their birth apparently averse to motion. In the course of a few weeks about a hundred of them made their appearance on the stone. I observed that, at first, each of them fixed itself for considerable time in one spot, appearing, as far as I could judge, to live by suction; but when a ray of light from the sun was directed upon it, it seemed disturbed, and removed itself to the shaded part of the stone. Out of about a hundred insects, not above five or six were born on the

* At the top of the sketch, and marked 14, 18, 22, 26.

south side of the stone; I examined some of them with the microscope, and observed that the smaller ones appeared to have only six legs, but the larger ones eight.

It would be superfluous to attempt a description of these little mites, when so excellent an one has been transmitted from Paris. It seems that they are of the genus *Acarus*, but of a species not hitherto observed. I have had three separate formations of similar insects at different times, from fresh portions of the same fluid, with the same apparatus. As I considered the result of this experiment rather extraordinary, I made some of my friends acquainted with it, amongst whom were some highly scientific gentlemen, and they plainly perceived the insect in various states. I likewise transmitted some of them to one of our most distinguished physiologists in London; and the opinion of this gentleman, as well as of other eminent persons to whom he showed them, coincided with that of the gentlemen of the Academie des Sciences, as to their genus and species. *I have never ventured an opinion as to the cause of their birth*, and for a very good reason—I was unable to form one. The most simple solution of the problem which occurred to me, was, that they arose from ova deposited by insects floating in the atmosphere, and that they might possibly be hatched by the electric action. Still I could not imagine that an ovum could shoot out filaments, and that those filaments would become bristles; and, moreover, I could not detect, on the closest examination, any remains of a shell. Again, we have no right to assume that electric action is necessary to vitality, until that fact shall have been most distinctly proved. I next imagined, as others have done, that they might have originated from the water, and, consequently, made a close examination of several hundred vessels filled with the same water as that which held in solution the silicate of potassa, in the same room, which vessels constituted the bulk of a large Voltaic battery, and without acid. In none of these vessels could I perceive the trace of an insect of that description. I likewise closely examined the crevices and most dusty parts of the door with no better success. In the course of some months, indeed, these insects so increased, that, when they were strong enough to leave their moistened birthplace, they issued out in different directions, I suppose in quest of food; but they generally huddled together under a card or piece of paper in their neighbourhood, as if to avoid light and disturbance.

In the course of my experiments upon other matters, I filled a glass basin with a concentrated solution of silicate of potassa without acid, in the middle of which I placed a piece of brick used in this neighbourhood for domestic purposes, and consisting mostly of silica. Two wires of platina connected either end of the brick with the poles of a Voltaic battery of sixty-three pairs of plates, each about two inches square. After many months' action, silica in a gelatinous state formed in some quantity round the bottom of the brick; and, as the solution evaporated, I replaced it by fresh additions, so that the outside of the glass basin, being constantly wet by repeated overflowings, was, of course, constantly electrified. On this outside, as well as on the edge of the fluid within, I one day perceived the well-known whitish excrescence, with its projecting filaments. In the course of time, they increased in number, and as they successively burst into life, the whole table on which the apparatus stood, at last was covered with similar insects, which hid themselves wherever they could find a shelter. Some of them were of different sizes, there being a considerable difference in this respect between the larger and

smaller; and they were plainly perceptible to the naked eye, as they nimbly crawled from one spot to another. I closely examined the table with a lens, but could perceive no such excrescence as that which marks their incipient state, on any part of it. While these effects were taking place in my electrical room, similar formations were making their appearance in another room distant from the former. I had here placed on a table, three Voltaic batteries unconnected with each other. The first consisted of twenty pairs of two-inch plates, between the poles of which I placed a glass cylinder filled with a concentrated solution of silicate of potassa, in which was suspended a piece of clay slate by two platina wires connected with either pole of the battery. A piece of paper was placed on the top of the cylinder to keep out the dust. After many months' action, gelatinous silica in various forms was electrically attracted to the slate, which it coated in rather a singular manner, unnecessary here to describe. In the course of time I observed similar insects in their incipient state forming around the edge of the fluid within the jar, which, when perfect, crawled about the inner surface of the paper with great activity. The second battery consisted of twenty pairs of cylinders, each equal to a four-inch plate. Between the poles of this I interposed a series of seven glass cylinders filled with the following concentrated solutions:—1. Nitrate of copper; 2. Subcarbonate of potassa; 3. Sulphate of copper; 4. Green sulphate of iron; 5 Sulphate of zinc; 6 Water acidified with a minute portion of hydrochloric acid; 7. Water poured on powdered metallic arsenic, resting on a copper cup, connected with the positive pole of the battery. All these cylinders were electrically united together by arcs of sheet copper, so that the same electric current passed through the whole of them.

After many months' action, and consequent formation of certain crystallized matters, which it is not my object here to notice, I observed similar excrescences with those before described at the edge of the fluid in every one of the cylinders, excepting the two which contained the carbonate of potassa, and the metallic arsenic; and in due time a host of insects made their appearance. It was curious to observe the crystallized nitrate and sulphate of copper, which formed by slow evaporation at the edge of their respective solutions, dotted here and there with these hairy excrescences. At the foot of each of the cylinders I had placed a paper ticket upon the table, and on lifting them up I found a little colony of insects under each, but no appearance whatever of their having been born under their respective papers, or on any part of the table. The third battery consisted of twenty pairs of cylinders, each equal to a three-inch plate. Between the poles of this I interposed likewise a series of six glass cylinders (fig. 2, A.), filled with various solutions, in only one of which I obtained the insect. This contained a concentrated solution of silicate of potassa. A bent iron wire (C.), one-fifth of an inch in diameter, in the form of an inverted syphon, was plunged some inches into this solution, and connected it with the positive pole, whilst a small coil of fine silver wire (B.) joined it with the negative. After some months electrical action, gelatinous silica enveloped both wires, but in much greater quantity at the positive pole; and in about eight months from the commencement of the experiment, on examining these two wires very minutely, by means of a lens, having removed them from the solution for that purpose, I plainly perceived one of these incipient insects upon the gelatinous silica on the silver wire, and about half an inch below the surface of the fluid, when replaced in its original position. In the course of time

more insects made their appearance, till, at last, I counted at once three on the negative and twelve on the positive wire. Some of them were formed upon the naked part of the wires, that is, on that part which was partially bare of gelatinous silica; but they were most imbedded more or less in the silica, with eight or ten filaments projecting from each, beyond the silica. It was perfectly impossible to mistake them, after having made oneself master of their different appearances; and an occasional motion in the filaments of those that had been the longest formed was very perceptible, and observed by many of my visitors, without my having previously noticed the fact to them. Most of these productions took place from half to three-quarters of an inch under the surface of the fluid, which, as it evaporated very slowly, I kept to the same level by adding fresh portions. As some of these insects (D. D. fig. 2) were formed on the inverted part of the syphon-shaped wire, I cannot imagine how they contrived to arrive at the surface, and to extricate themselves from the fluid: yet this they did repeatedly; their old places were vacated, and others were born in new ones. Whether they were in an imperfect state (except just at the commencement of their formation), or in a perfect one, they had all the distinguishing characteristics of bristles projecting from their bodies, which occasioned the French *savans* to remark that they resembled a microscopic porcupine.

I must not omit to state, that the room in which these three batteries were acting was kept almost constantly darkened. It was not my intention to make known these observations until I myself should be better informed about the matter. Chance led to the publication of an erroneous account of them, which I was under the necessity of explaining. It is so difficult to arrive at the truth, that mankind would do better to lend their assistance to explore what may be worth investigating, than to endeavour to crush in its bud that which might otherwise expand into a flower. In giving this account, I have merely stated those circumstances regarding the appearance of insects, which I have noticed during my investigations into the formation of mineral matters; I have never studied physiology, and am not aware under what circumstances the birth of this class of insects is usually developed. In my first experiment I had made use of flannel, wood, and a volcanic stone: in the last, none of these substances were present. I never for a moment entertained the idea that the electric fluid had animated the organic remains of insects, or fossil eggs, previously existing in the stone or the silica; and have formed no visionary theory which I would travel out of my way to support.

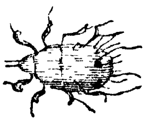
I have since repeated these latter experiments in a third room, in which there are now two batteries at work. One consisting of eleven pairs of cylinders, made of four-inch plates, between the poles of which is placed a glass cylinder, filled with silicate of potassa, in which is suspended a piece of slate between two wires of platina, as before, and covered loosely with paper. Here, again, is another crop of insects formed. The other battery consists of twenty pairs of cylinders, the electric current of which is passed through six different solutions in glass cylinders, in three of which only is the insect formed, viz., 1st, in nitrate of copper; 2dly, in sulphate of copper, in each of which the insect is only produced at the edge of the fluid, as far as I can make out; and 3dly, by the old apparatus of coiled silver and iron wire in silicate of potassa, as before. There are now forming on the bottom of this positively electrified wire similar insects, at the distance of fully two inches below the surface of the fluid. On examining them, I have lately noticed a peculiar quality they possess

whilst in an incipient state. After being kept some minutes out of the solution, they contract their filaments, so as, in some cases wholly, and in others partially, to disappear: I at first thought they were destroyed; but, on examining the same spots on the next day, they were as perceptible as before. In this respect they seem not unlike the zoophytes, which adhere to the rocks on the sea-shore, and which contract on the approach of a finger. I may likewise remark, that I have not been able to detect their eyes, even when viewed under a powerful microscope, although I once fancied I perceived them. The extreme heat of summer and cold of winter do not appear favourable to their production, which succeeds best, I think, in spring and autumn. As, in the above account, I have occasionally made use of the word "formation," I beg that it may be understood that I do not mean *creation*, or anything approaching to it.

I am not aware that I have anything more to add, except the few remarks I shall conclude with. 1st. I have not observed a formation of the insect, except on a moist and electrified surface, or under an electrified fluid. By this I do not mean to assert that electricity has anything to do with their birth, as I have not made a sufficient number of experiments to prove or disprove it; and, besides, I have not taken those necessary precautions which present themselves even to an unscientific view. These precautions are not so easy to observe as may at first sight appear. It is, however, my intention to repeat these experiments, by passing a stream of electricity through cylinders filled with various fluids under a glass receiver, inverted over mercury, the greatest possible care being taken to shut out extraneous matter. Should there be those who blame me for not having done this before, to such I answer, that independent of a host of other hindrances, which it is not in my power to set aside, I have been closely pursuing a long train of experiments on the formation of crystalline matters by the electric agent, and on different modifications of the Voltaic battery; in which I am so interested, that none but the ardent can conceive what is not in my power to describe. 2dly. These insects do not appear to have originated from others similar to themselves, as they are formed in all cases, with access of moisture, and, in some cases, two inches below the surface of the fluid in which they are born; and if a full-grown and perfect insect be let fall into any fluid, it is infallibly drowned. 3dly. I believe they live for many weeks; occasionally, I have found them dead in groups, apparently from want of food. 4thly. It has been frequently suggested to me to repeat these experiments without using the electric agency; but this would be by no means satisfactory, let the event be what it would. It is well known that saline matters are easily crystallized, without subjecting them to the electric action; but it by no means follows that, because artificial electricity is not applied, such crystals are formed without the electric influence. I have made so many experiments on electrical crystallization, that I am firmly convinced in my own mind, that electric attraction is the cause of the formation of every crystal, whether artificial electricity be applied or not. I am, however, well aware of the difficulty of getting at the truth in these matters, and of separating cause from effect. It has often occurred to me, how is it that such numbers of animalcules are produced in flour and water, in pepper and water; also, the insects which infest fruit-trees after a blight? Does not a chemical change take place in the water, and likewise in the sap of the tree, previous to the appearance of these insects? and is, or is not, every chemical change produced by electric agency?

From a subsequent letter from Mr. Crosse, dated Broomfield, near

Taunton, 12th Jan. 1838:—" Since writing the former account, I have obtained the insects on a bare platina wire, plunged into fluo-silicic acid, one inch below the surface of the fluid, at the negative pole of a small battery of two-inch plates, in cells filled with water. This is a somewhat singular fluid for these insects to breed in, who seem to have a flinty taste, although they are by no means confined to silicious fluids. This fluo-silicic acid was procured from London some time since, and, consequently, made of London water; so that the idea of their being natives of the Broomfield water is quite set aside by this result. The apparatus was arranged as follows (reference to fig. 3 of the Illustrations). Fig. 1. A glass basin (a pint one), partly filled with fluo-silicic acid to the level 1. Fig. 2. A small porous jar, made of the same material as a garden, partly filled with the same acid to level 2, with an earthen cover, fig. 3, placed upon it, to keep out the light and dust. Fig. 4. A platina wire, connected with the positive pole of the battery, with the other end plunged into the acid in the pan, and twisted round a piece of common quartz; on which quartz, after many months' action, are forming singularly beautiful and perfectly formed crystals, of a transparent substance, not yet analyzed, as they are still growing. These crystals are of the modification of the cube, and are of twelve or fourteen sides. The platina wire passes under the cover of the pan. Fig. 5. A platina wire, connected with the negative pole of the same battery, with the other end dipping into the basin, an inch or two below the fluid, and, as well as the other, twisted round a piece of quartz. By this arrangement it is evident that the electric fluid enters the porous pan by the wire 4, percolates the pan, and passes out by the wire 5. It is now upwards of six or eight months (I cannot at this moment put my hand on the memorandum of the date) since this apparatus has been in action: and, though I have occasionally lifted out the wires to examine them by a lens, yet it was not until the other day that I perceived any insect; and there are now three of the same insects in their incipient state, appearing on the naked platina wire at the bottom of the quartz, in the glass basin at the negative pole (fig. 6.) These insects are very perceptible, and may be represented thus, magnified (fig. 4):—1. The platina wire; 2. The quartz; 3. The incipient insects. It should be observed, that the glass basin (fig. 1) has been always loosely covered with paper. This frosty weather is unfavourable to these experiments."



(Cheese-mite magnified.)

(The Crosse Insect magnified.)

In the preceding woodcuts, besides Mr. Crosse's apparatus, are specimens of the insect magnified; with an ordinary cheese-mite near them, drawn to the same scale, in order to show the relative size, and the similarity of appearance. Like the mite, the new insect has fine hairs scantily distributed on the body; but, in the cut, these are invisible, from the immersion of the specimens in balsam, and their inclosure between plates of glass and talc, so as to be easily submitted to examination in the microscope.*

AN EXPERIMENTAL INQUIRY INTO THE MODES OF WARMING AND VENTILATING APARTMENTS.

By Andrew Ure, M. D., F. R. S.

The author having been consulted by the Directors of the Customs Fund of Life Assurance, on the mode of ventilating the Long Room in the Custom House, and deeming the subject one of great public interest, was induced to lay the result of his observations and experimental inquiries before the Royal Society. In this room, about two hundred persons are busily engaged in transacting the business of the Institution. All these persons are found to suffer more or less from ailments of the same general character, the leading symptoms of which are a sense of fulness and tension in the head, flushing of the face, throbbing of the temples, giddiness, and occasional confusion of ideas, depriving them of the power of discharging their duties, in which important and frequently intricate calculations are required to be gone through. These symptoms of determination of blood to the head are generally accompanied by coldness and languid circulation in the feet and legs, and by a feeble, and frequent, as well as quick and irritable pulse. On examining the air of the room by appropriate instruments, the author notices more especially three circumstances in which it differs from the external air: first, its temperature, which is maintained with great uniformity within a range of 62° to 64°; secondly, its extreme dryness, which, on one occasion, measured by Daniell's hygrometer, was 70 per cent.; and, thirdly, its negatively electrical state, as indicated by the condensing gold-leaf electrometer. In all these qualities the air respired by the inmates of the room bears a close resemblance to the pestilential blasts of wind which, having passed rapidly over the scorching deserts of Arabia and Africa, constitute the *Simoom* of those regions, and are well known by their injurious effects on animal and vegetable life. To these noxious qualities is superadded, as in the air of all rooms heated through the medium of cast-iron pipes or stoves, an offensive

* Upon this inquiry Mr. John Murray, F. S. A., F. L. S., &c., has published a very able and interesting pamphlet, entitled "Considerations on the Vital Principle; with a Description of Mr. Crosse's Experiments." London: E. Wilson. 1837.—The preceding details are quoted from the Literary Gazette, No. 1097; and the second Engraving of the Insects from the Magazine of Popular Science, No. 14.

smell, arising partly from the partial combustion of animal and vegetable matters always floating in the atmosphere of a town, and perhaps also from minute impregnations of carbon, sulphur, phosphorus, or even arsenic, derived from the metal itself. The author expresses his surprise that, in the recent report of the Parliamentary Committee on the subject of ventilation, no reference is made to the methods employed for that object in factories, although they afford the best models for imitation, being the results of innumerable experiments made on a magnificent scale, with all the lights of science, and all the resources of the ablest engineers. He proceeds to describe these methods; and is then led to investigate the comparative efficiency, with a view to ventilation, of a draught of air resulting from a fire and chimney, and that produced by the rotation of a fan-ventilator. He shows that a given quantity of coal employed to impart motion to the latter, by means of a steam engine, produces a ventilating effect thirty-eight times greater than can be obtained by the consumption of the same fuel in the ordinary mode of chimney ventilation. Accordingly, he strongly advises the adoption of the former in preference to the latter; and inveighs against the stove-doctors of the present day, who, on pretence of economy and convenience, recommend the slow combustion of a large body of coke, by means of a slow circulation of air; under which circumstances, it is well known to chemists, that much carbonic oxide, a gas highly pernicious to all who respire it, is generated; accompanied, at the same time, by a comparatively small evolution of heat. In order to obtain the maximum quantity of heat from a given mass of fuel, its combustion, he observes, should be very vivid and the evolved caloric should be diffused over the largest possible surface of conducting materials; a principle which has been judiciously applied in several French factories. It has been proved that work-people employed in calico-drying rooms, heated according to the plan here reprobated, become wan, emaciated, and diseased; while in rooms in which the air is more highly heated by means of steam-pipes, they preserve their health and florid complexion.*

ON THE EXISTENCE OF STRUCTURE IN THE ASHES OF PLANTS, AND THEIR ANALOGY TO THE OSSEOUS SYSTEM IN ANIMALS.

By the Rev. J. B. Reade, M.A.

HAVING been requested by Mr. R. Rigg,—an able analytical chemist, whose valuable researches into the composition of vegetable products will ere long be made public,—to examine the ashes of plants with the microscope, I procured a platinum spoon and a large spirit-lamp as my working apparatus. Portions of plants were then submitted to an intense heat, until the carbonaceous parts were entirely dissipated, and only a few apparently

* Proceedings of the Royal Society; quoted in the Philosophical Magazine, No. 58.

white ashes remained. The specimens thus incinerated consisted chiefly of grasses, together with barley, wheat, &c., and in all of them I have been able to discover, by means of the microscope, a most beautiful, and in many a most elaborate, structure. That this detection of structure in the ashes of plants is altogether new, I must infer from the silence of our best writers on the subject of physiological botany. The fact, had it been known, would have appeared far too interesting and important to be dismissed without special notice. The commonly conceived opinion is, to use the words of Professor Henslow, that carbon fixed under the form of a nutritive material is elaborated for the developement of *all parts* of vegetable structure, and that those earthy, saline, and metallic ingredients, which are found in the ashes of plants, *being accidentally introduced*, cannot with any certainty be looked upon as products of vegetation, or as ever constituting essential elements of organization.*

Now, since the presence or absence of organization is direct evidence of the presence or absence of life, the first thing which strikes the mind under this newly-discovered feature in the ashes of plants is, that combustion does not, in this case, as we have hitherto supposed, supply us with brute matter merely, but that it leaves behind a purely vegetable product, a product far from being dissimilar in its nature to *the bones of animals*, and having its particles undoubtedly arranged by the agency of a living principle. Yet I confess that these are somewhat startling novelties; indeed, so much so, that I almost shrink from bringing before the naturalist a statement, which to say the least, will be at first received with suspicion. The facts, however, he may easily verify for himself, and I can only believe that an examination similar to my own will conduct him to a similar conclusion.

It is almost superfluous to observe that bones contain, in addition to animal matter, salts of lime and soda, together with traces of silica and metallic oxides. The ashes of plants also, as is equally well known, are composed of earthy, saline, and metallic ingredients. We have here, therefore, two products, the one animal, and the other vegetable, differing chiefly in the proportions of similar elements. If it be asked how these elements are distributed in plants, whether in accidental accumulations or uniformly dispersed throughout their volume, all we know of creating intelligence urges us to say, that certainly the dispersion will be uniform, or at least systematic. We cannot, therefore, be surprised to learn that such an arrangement is actually detected after combustion, though it may be gratifying to know that combustion does not disturb so as to conceal it.

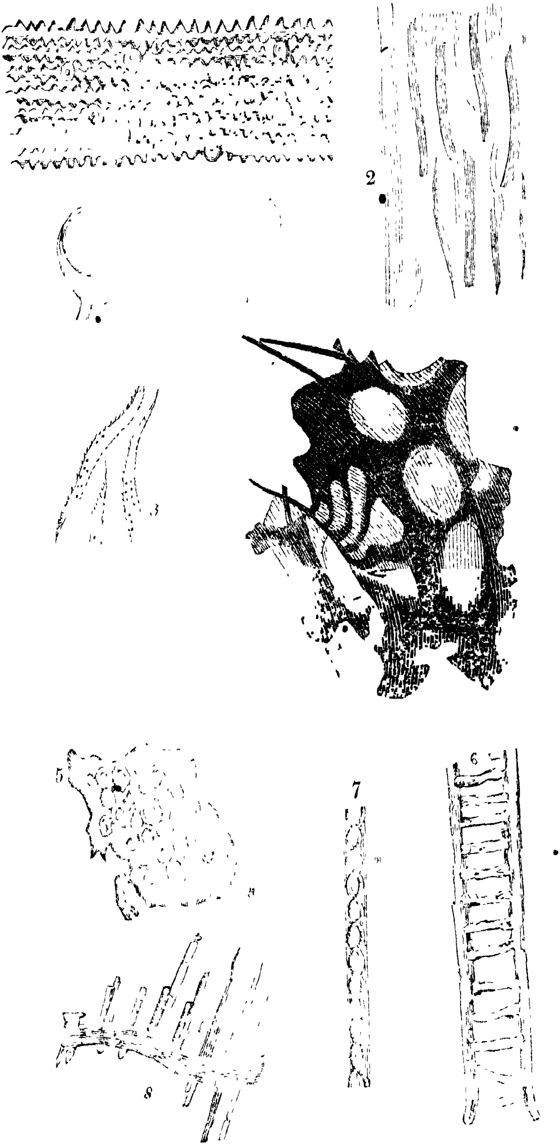
What I wish then more especially to insist upon with respect to the ashes of plants is *structure*,—the similar conformation of

* Cabinet Cylopædia, Principles of Botany, pp. 176, 177, 224, &c.

similar parts, whether those parts be stems, leaves, or the appendages of flowers and seeds. The variety is evidently a variety of purpose and plan, compelling us to reject at once every supposition of the operation of causes without design. The inability to comprehend the use of this construction is no argument against the subtlety of the mechanism.—The bare existence of structure is of itself proof sufficient of the active presence of a living principle, and therefore of a contrivance accommodated to some end, and suited to some office. That end and office, in the present case, may be to give consistence and support, or there may be some mysterious connexion even with the healthy existence of the plant. For did we find the deposition of matter, like *silica* along the angles of the *Equisetum hyemale*, occurring in small masses, or as lumps, like tabasheer between the joints of the bamboo, we might with justice suppose, that what seems to be so casually introduced might be withheld, or, if possible, removed, without interfering with the process of vegetation. But since the residual matter which combustion separates is, as it were, carefully arranged, in certain definite forms, throughout the entire plant, those forms varying uniformly in different parts of the same plant, but preserving many similar characters in similar parts of different plants, we cannot suppose that there is no connexion between structure like this, and the general economy of vegetation, or that so concealed but curious a contrivance has no share and interest in the functions of vegetable life.

We may also further infer, that there is a *chemical union* of the earthy, saline, and metallic ingredients, which the ashes of plants contain. If these ashes were wholly destitute of structure, we might with justice suppose that they contained their elements in mechanical combination merely, each particle being a pure portion of a separate element. But the fact of organization compels us to conclude that, in each and every particle of the incombustible residuum, every element is combined under the operation of a natural chemistry: And hence, under this impression, we can pronounce the ashes of plants to be a purely vegetable product, equally with the nutritive products, starch, sugar, and gum.

Whether the physiologist will condemn as fanciful and vague any idea of analogy between the bones of animals and this systematic distribution of incombustible matter in plants; or whether,—bearing in mind that created things differ in magnitude pre-eminently,—he will be disposed to confirm such speculations; these are points which I cannot decide. Of this, however, I feel confident, that every lover of the microscope will be glad to place in his cabinet a series of objects, which, to say the least, will call forth his admiration, if they do not also awaken a suspicion that he is examining structure which has been obedient to some rule, and is therefore conducive to some effect.



(Ashes of Plants.)

Note.—The above observations may possibly tend to throw some light on the natural process of the silicification of wood. By the agency of an intense heat the surrounding siliceous matter may be liquefied, and the carbon and gaseous products of the wood dispelled, while the essential characters of the fibrous and cellular structure are undisturbed. The unconsumed portions, which alone constitute the true vegetable fame-work, are then, as it were, *mounted* in the fluid silica. This property of retaining its form notwithstanding the action of heat, which seems to be a characteristic of fibre, suggested to me the probability of detecting structure in the ashes of coal; and, upon examination, I find that the white ashes of "slaty coal" furnish most beautiful examples of vegetable remains. We have thus additional evidence that the *basis* of vegetable structure is independent of carbon.*

Explanation of the preceding Figures.

Figs. 1, 2, 3. Skeletons of portions of recent plants.
1. Part of husk of Oat, with separate drawings of the cups, which are attached at nearly uniform intervals along the siliceous columns.
2. Part of leaf of the Iris.
3. Hair of leaf of *Cornus alba* (Common Dogwood).

Figs. 4, 5, 6, 7, 8. Siliceous skeletons of portions of plants occurring abundantly in the white ashes of coal.
4, 5. Cellular structure.
6. Annular ducts with transverse bars.
7. Spiral fibre.
8. Fibre *in situ*.

Magnifying power about three hundred linear. The parallel siliceous lines of the Oat, occurring in some cases at intervals of 1-4000dth of an inch, from a very delicate *natural micrometer*.

P. S. Since writing this paper, I have been indebted to Mr. Brown's kindness for the perusal of Struve's Inaugural Dissertation, "De Silicia in Plantis nonnullis." It is the author's object to show that pure silicia forms the skeleton of three species of *Equisetum*, and also of the *Spongia lacustris* and *Calamus Rhodan*. I am gratified by finding the following remark :—"Sub aëris libero aditu ustis, restat sceleton, totam plantæ formam accurate servans, partibus animalium osseis quam maxime comparandum." p. 12.

My attention has also been directed to Mr. Lyell's observations on Göppert's Memoir on the Process of Lapidification, Phil. Mag., May, 1837, p. 408, and Ehrenberg's Memoirs on Fossil Infusioria, Scientific Memoirs, vol. i. part iii.

* Philosophical Magazine, No. 64.

NATURAL HISTORY.

ZOOLOGY.

THE HEMIRAMPHUS.

Letter from Dr. Clarke, of Ipswich, to William Yarrell, Esq., Secretary of the Zoological Society, noticing the recent Occurrence of the Fry of a Species of Hemiramphus on the Coast of Suffolk; with some additional Observations by Mr. Yarrell.

As I find in your valuable work on the British fishes, at the termination of the Esocidæ, you have given as a vignette the head of a fish, (a species of Hemiramphus,) which has been considered a doubtful visitant of our shores, and which hitherto appears only to have been observed by Mr. Couch, I have great pleasure in forwarding to you a couple of specimens of this interesting genus, which were captured upon the Suffolk coast.

The circumstances attending the discovery of these fish are as follows, viz.:—My brother, (Mr. Edward Clarke, of Ipswich), who is particularly interested in the study of British fishes, was examining the sea shore in the vicinity of Felixtow,* a few days ago, (on August 7, 1837,) when he observed a shoal consisting of myriads of small fish, which upon a nearer examination, he supposed to be the young of the garfish. As he had previously not found any so small, he secured a few specimens; and, upon bringing them home and examining them, they were found not to be the young of the garfish, but those of a species of Hemiramphus. From their being so very young, it probably may be difficult to determine whether they belong to a described species; but, from the circumstance of their having been seen in great abundance in a small pool left by the retiring tide, it is, I think, pretty evident that the ova must have been deposited and vivified in the neighbourhood of our shores. I send you the fish, thinking that an examination of the specimens themselves will be far more satisfactory than any figures or description of my own. One specimen was taken about double the size of those now sent to you.

Letter from Mr. Yarrell to the Editor of "Loudon's Magazine of Natural History."

I have great pleasure in transfering to your hands, for insertion in the *Magazine of Natural History*, the letter received from our friend Dr. Clarke of Ipswich. I have had a drawing made from one of the specimens of this interesting little fish, half as large again as the natural size, which, with the remarks that follow, is equally at your disposal.

* A village in Suffolk, between Harwich and Orford.

Mr. Couch's observations on the single example of a species of Hemiramphus which occurred to him are as follows:—"I have met with a species which I have never seen described, unless it be the Esox Brasiliensis *Linn. Syst. Nat.* It was taken by me in the harbour at Polperro, in July, 1818, as it was swimming with agility near the surface of the water. It was about an inch in length, the head somewhat flattened at the top, the upper jaw short and pointed, the inferior jaw much protruded, being at least as long as from the extremity of the upper jaw to the back part of the gill-covers. The mouth opened obliquely downwards; but that part of the under jaw which protruded beyond the extremity of the upper, passed straight forward in a right line with the top of the head. The body was compressed, lengthened, and resembled that of the garpike, (E. Belone). It had one dorsal and one anal fin, placed far behind and opposite to each other. The tail was straight; the colour of the back was a bluish green, with a few spots; the belly silvery."

This notice, which appeared in the 14th volume of the *Linnæan Transactions*, induced me to insert as a vignette in the *History of British Fishes* the head of a species of Hemiramphus, in order to draw the attention of observers on our coast to the subject; and it is a sincere gratification to me to know that it has had the effect intended. It can scarcely be doubted, from the quantity of fry seen, as well as from their very small size, that the spawn from which they were produced must have been deposited on our shores by the parent fish; and yet, as far as we are aware, these parent fish have hitherto escaped capture. This might not appear very extraordinary, but from the circumstance that the size attained by the fry in the months of July and August, as well as the general similarity in the form and appearance of the Hemiramphus to our well-known garfish and saury-pike, would lead to the belief that the Hemiramphus visited our shores about the same time of the year as these fishes. The garfish appears on the coast in April, and spawns in May. The saury-pike makes its first appearance in June. For these fish, but particularly for the first of them, nets are worked on various parts of the coast, and considerable quantities are taken; but no adult specimens of the Hemiramphus, unless we are to suppose they have remained hitherto unrecognised by the fishermen. It is also not a little singular, that, up to the present time, with the exception of the small specimens already referred to, as taken at two places very distant from each other, no example of any species of Hemiramphus had been found, either in the Mediterranean, the Channel, or the North Seas. I have lately had an opportunity of conversing with two eminent foreign naturalists, to whom I showed the specimens, who agreed with me that no adult species of Hemiramphus had been recorded as found in the European seas. The examples taken by Dr. Clarke are too young, and too minute, to make any attempt to define

specific characters desirable, beyond such as the remarks of Mr. Couch, and the representation here given will supply; and

(Hemiramphus Europæus. Yarrell.)

I would only propose, for distinction's sake, that it should be called Hemiramphus Europæus.*

CHARACTERS OF A NEW FORM IN THE FRINGILLIDÆ.

By Andrew Smith, M.D., Surgeon to the Forces, Superintendent of the late Expedition for exploring the Interior of South Africa.

In the many instances in which we have already detected, amongst birds, well-defined natural groups, we have found a certain harmony of characters pervading the entire of their species; indeed, it has been that evident harmony which led to their being regarded as natural groups. It is true, in each group some species are found which do not exhibit all the characters of the more typical ones; yet they nevertheless present us with sufficient indications of their relationship to enable us at once to perceive their proper connexions.

If, then, the existence of these marked corresponding characters are to be regarded as the essence of such groups, it will be necessary whenever a species presents itself which does not possess the qualifications requisite for admitting it amongst forms already established, to view it as a legitimate object for the type of a new subdivision. Under such circumstances, the Sociable Finch of Southern Africa presents itself to our notice. Whilst no one will deny this bird a place in the Fringillidæ, most observers will admit it deficient in the series of subordinate characters which would admit of its being properly included in any of the yet characterized sub-divisions of the family; and, in proof of what we have affirmed, no two original observers have hitherto placed it in the same genus. By the most accurate inquirers, it has either been placed in the Ploceus of Cuvier or the Euplectes of Swainson.

Unless we are to allow the characters of a group to stand so loosely defined as to admit of the introduction of forms so remote from the typical ones, that no two observers would, in all probability, refer them to the same genus, we cannot possibly regard the bird now under consideration as appertaining either to Ploceus or Euplectes. It has not that series of external characters which would establish its place either in the one or the other; and its resorts and habits are directly opposed to both;

* Magazine of Natural History, No. 10.

unless it be believed that we have already sufficient evidence to warrant the conclusion, that every natural genus must of necessity have certain modified forms as representatives of other genera

If it is to be discarded from any connexion with either of the above genera, its legitimate position is far from evident: and, therefore, to speculate upon probabilities might only increase that obscurity. What is quite incomprehensible with our present materials, will doubtless become evident when most of the stores which nature has still in reserve shall have been accumulated: and, till then, any labour directed otherwise than to that end will, in all likelihood, only prove labour lost. For the reception of this South African bird, I would, then, propose the

Subgenus PHILETAIRUS.

Bill rather long, and pointed, higher than broad, and entering between the feathers of the forehead: culmen rounded and curved; commissure sinuated; edges of mandibles slightly inflexed: nostrils near base of upper mandible, round, and behind edged with feathers; a few short rigid bristles at angles of mouth. *Wings* moderate; when closed, covering half the tail; three outermost quill-feathers nearly of equal length, and the longest. *Tail* rounded. *Legs* strong, scutellated in front; middle toe considerably longer than the lateral ones, which are nearly of equal length, and shorter than the hinder one. *Claws* strong, compressed, curved, and pointed.

PHILETAIRUS LEPIDUS. (Ploceus socius *Cuvier*, Euplectes lepidus *Swainson.*)

Male. The upper parts of the head and the back drab brown; the sides of the neck, the interscapulars, and a longitudinal stripe in front of each leg at base, black or black-brown; the feathers margined with Isabella; chin, and a stripe between it and anterior angle of each eye, pure black; sides of head and under parts of body, Isabella; quill and tail feathers dark brown; the latter, towards tips, of an Isabella tint; bill a pale horn-colour, inclining to bluish white towards point. Length, from shoulder to tip of wings 2″ 10‴; tail, 1″ 10‴; tarsus, 10‴; bill, 8‴. Total length of bird, 5 in.

Female. No black on the chin or at the base of mandibles; in other respects resembles the male.

Inhabits the interior of Southern Africa, and is generally found in dry arid situations. A great many individuals are usually found associated together; and under one common roof they build their nests, which in some cases form such large and weighty masses as to break the strong branches of large and lofty trees, upon which they usually place them. In its manners, it resembles the Pyrgitæ, and still more, perhaps, the Plocepasser, a small African group, first indicated by me in June, 1836.*

* Magazine of Natural History, No. 10.

HABITS OF THE BOAT FLY, (NOTONECTA GLAUCA.)

Mr. Main, of Chelsea, relates:—I once resided near a pond which was formed for the use of ducks and geese, in which there were myriads of these insects; but, during the whole term of my residence of fifteen years on the spot, and passing the pond once, and often many times, in a day, I never once observed the ascent of a single beetle out of the water; but have, times out of number, witnessed their *descent* in vast numbers; and therefore conclude that they must have risen in the night, or early in the morning, or come from some distance to merge themselves in the pond during the day.

They descend like ærolites; but from what height, no opinion can be formed. Their descent is, however, soon observed and announced by the bustle of the ducks, who are quickly on the alert, either with an eye turned anxiously upward, or dashing to seize a beetle which has just plunged into the water. The insects drop with their wings folded, their own weight only, apparently, bringing them down; and though their descent through the air is most rapid, their motion downwards in the water is rather slow: because from the flatted form of their bodies, and that of their oar-like feet, they can only descend in spiral curves.

It is during the devious descent that the ducks are able to capture the precious morsel of their food; and the energy and alacrity displayed by the flock, during a fall of the insects, is really an amusing scene. Many an hour have I spent in witnessing this sportive scramble of the ducks and ducklings in this guiltless pursuit. Some fluttering along the surface, others diving, and all as eager after every beetle that drops as the keenest fox-hunter with the chase in view.

That the sight of the insects is not very powerful when they begin to descend becomes evident from the circumstance of their often mistaking any other reflecting surface for that of water. For instance, they drop frequently on the roofs of hot-houses, skylights, and glazed garden frames. Indeed, I never could account for their *rattling* down upon the frames in such numbers until I lived near the duck pond; for then it was I learnt the cause of their mistaking glass for water.

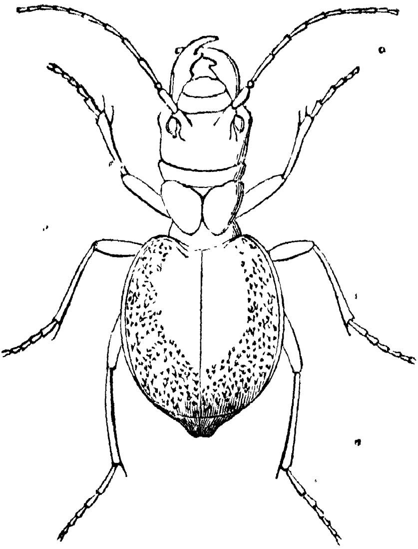
The insects fall out of the air with such force that the noise of their plunge is exactly like that of a small pebble or leaden bullet thrown, from a considerable height, perpendicularly, into deep water; and this bubbling sound often called my attention to the phenomenon, which, in the absence of ducks, would have otherwise escaped notice.

I have reason to believe that the common water shrew feeds on these insects, when, in his short foraging excursions, he can capture them in the mead.*

* Magazine of Natural History, No. 10.

NEW COLEOPTEROUS INSECT OF THE GENUS MANTICORA.

THE genus Manticora, in most modern classifications, stands at the head of the Cicindelidæ, and appears to be connected with the more typical species of that family, by means of the genera Platychile *Macleay* and Megacephala *Latreille*. Of this genus hitherto but one species has been known; we are now, however, (through the indefatigable exertions of Dr. Andrew Smith,) made acquainted with a second.



(New Insect: Manticora.)

This species, Dr. Smith informs me, he discovered near Kurrichane, in a clump of dead trees. It is of a larger size than the Manticora maxillosa, which has long been known as an inhabitant of the Cape of Good Hope; the most striking difference, however, between our present species and that just referred to consists in the greater proportionate width of the elytra; I would therefore suggest for it the specific name of *latipennis*. It may be characterized, — M. atra Elytris subcordatis, latis, scabris; longitudo corporis, $21\frac{1}{2}$ lin.; latitudo, 10 lin.

Upon comparing M. latipennis with M maxillosa, the following differences may be observed:—In the former, the head is larger, exceeding that of the latter nearly one line in length, and about half a line in breadth. It is also more sparingly punctured on the upper parts, and so is likewise the thorax.

The elytra, as before stated, are much broader, (having the proportion of ten to eight,) less convex, the lateral margins are more distinctly recurved, and the minute pointed tubercles, which are observed on the elytra of both species,) are not quite so distinct, nor do they extend so far inwards as in M. maxillosa. The disc of the elytra is smooth, rather glossy, and has a pitchy hue.*

* Magazine of Natural History, No. 9.

NOTES ON THE HAWFINCH, (COCCOTHRAUSTES VULGARIS, CUV.,) AS OBSERVED IN THE VICINITY OF EPPING FOREST.

By Henry Doubleday, Esq.

By nearly all our writers on ornithology, the Hawfinch has been considered as only a visitor of the British Islands, and these visits have been supposed to be confined to the winter season, and to occur at rather uncertain periods.

Situate in a locality where these birds abound, I have for some years past given close attention to their habits, and I can safely assert, that they are permanent residents, nor can I perceive any addition to their numbers by the arrival of foreigners at any period of the year.

Their extreme shyness has no doubt contributed to keep us in ignorance of their habits and economy: in this trait they exceed almost any land bird with which I am acquainted, and in open places it is almost impossible to approach them within gunshot.

Their principal food here appears to be the seed of the Hornbeam, (*Carpinus betula*, Linn.), which is the prevailing species of tree in Epping forest; they also feed on the kernels of the haws, plum-stones, laurel-berries, &c., and in summer make great havoc among green peas in gardens in the vicinity of the forest.

About the middle of April they pair, and in a week or two commence nidification. The situation of the nest is various, but is most commonly placed in an old scrubby whitethorn bush, often in a very exposed situation; they also frequently build on the horizontal arms of large oaks, the heads of pollard hornbeams, in hollies, and occasionally in fir trees in plantations, the elevation of the nest varying from five to twenty-five or thirty feet.

The most correct description of the nest which I have seen is in Latham's Synopsis. It is there said to be composed of the dead twigs of oak, honeysuckle, &c. intermixed with pieces of grey lichen; the quantity of this last material varies much in different nests, but it is never absent: in some it is only very sparingly placed among the twigs, in others, the greater part of the nest is composed of it; the lining consists of fine roots and a little hair.

The whole fabric is very loosely put together, and it requires considerable care to remove it from its situation uninjured.

The eggs vary in number from four to six, and are of a pale olive green, spotted with black, and irregularly streaked with dusky. Some specimens are far less marked than others, and I have seen some of an uniform pale green.

The young are hatched about the third week in May, and as soon as they are able to provide for themselves, they unite with the old birds, in flocks varying in numbers from fifteen or twenty to one or even two hundred individuals.

In this manner they remain through the winter, feeding on the hornbeam seeds which have fallen to the ground, and only separate at the approach of the breeding season.

I believe the male has no song worth notice: in warm days in March I have heard them, when a number have been sitting together on a tree, uttering a few notes in a soft tone, bearing some resemblance to those of the Bullfinch.

The plumage of the young bears considerable resemblance to that of the young Greenfinch: the throat is bright yellow; head, neck, and upper parts olive-brown; the under parts paler, each feather tipped with brown.

In winter the bill is a pinkish horn-colour, but becomes deep blue in the breeding season.

Although so common in this neighbourhood, the hawfinch is but little known, which is to be attributed to its shy and retired habits, and I have little doubt it is found in most parts of the kingdom where the hornbeam is abundant.* In this vicinity it seems rapidly increasing, and will probably ere long be equally common with its ally the Greenfinch.†

PARMACELLA, (CUVIER.)

MM. WEBB and VANBENEDEN have attentively examined the American mollusca reputed to belong to this genus in the rich collection of the late Baron de Ferussac, and the result is the establishment of a new genus, (*Peltella*), for their reception, the organic differences between them and those of the old continent being so considerable as to justify their separation. This division besides has the advantage of fixing in a precise manner the geographical distribution of the two genera. The Parmacellæ appear to belong more particularly to Northern Africa, one species only having been met with at the western extremity of Europe, and in one of the warmest regions of the Iberian Peninsula. We may then presume, that when the *Limacidæ* of the north of Africa are better known, the group to which they, (the Parmacellæ), belong will present a series of species similarly conformed, and replacing in those climates the slugs of our temperate regions. The European species is minutely described and figured in a late No. of *Guerin's Mag. de Zoologie.* It was found on the hills of Alcantara behind Lisbon, feeding on the young shoots of *Cochlearia acaulis*, and is characterized as follows:

Parmacella Valenciennii, corpore toto fulvo, reticulatim rugoso; concha scutello obvoluta, tenui, diaphana, fragilissima; spiræ rudimento instructa, basi motaria ambitu sinuata.‡

* This is not the case, nor is it a natural consequence to the abundance of the Hornbeam.

† Magazine of Zoology and Botany, No. 5.

‡ Webb and Vanbeneden in Mag. de Zoologie; quoted in the Magazine of Zoology and Botany, No. 5.

ON THE SEXES OF SOME CRUSTACEANS.

It is to be observed that, in regard of sex, the Cancroidea differ not only in being male and female, but there are also barren or spurious females, of which the broadly-trigonate abdomen is narrower than in genuine females, although broader than in the males. These are not to be confounded with young females whose abdomen, as in the Majaceæ, is flatter than in the adults, for of several species there are both barren and fruitful individuals of the same age. The Cancroidea and Matutoidea are hitherto the only families in which these sterile females have been noticed. *Portunus*, (Neptunus), pleagicus, sanguinolentus; (Amphitrite,) gladiator, hastatoides; (Charybdis,) miles, 6-dentatus; (Thalamita,) truncatus; *Ocypode*, (Macrophthalmus,) japonica: (Helice,) tridens; *Grapsus*, (Eriocheir,) japonicus; (Grapsus,) marmoratus have afforded specimens of them. The form of the abdomen of the spurious females is trigonate in all the Portuni, but in P. sexdentatus the joints are arched on the side, and constricted at the apex and base, in Oxypode and Grapsus, differing from the former, it is wider than the half of the breadth of the sternum, while of a genuine female it occupies the whole breadth, and the apical joint is trigonal not dilated. The ovigerous appendages, or, as their use would warrant us in calling them, the spurious feet, are fringed with long hairs in the females, but on the contrary in the neuters they are either smooth or very shortly hairy. The organs of the body agree mostly with those of the females, but Portunus miles offers a difference in the claws, and P. truncatus both in the claws and front.*

MIGRATORY BIRDS IN 1836.

In the northern parts of England the effects and influence of season upon the movements of migratory birds, has been strongly exemplified during the present year. The cold and ungenial weather during the months of March, April, and May, delayed the arrival of most of our summer visitants from ten to fourteen days beyond the average period of their first appearance, as deduced from a journal annually kept for more than fifteen years.

It was also generally remarked that they were much fewer in numbers, and that some species were altogether absent in localities where in previous years they had been abundant.

The departure of the *Sylviadæ*, as well as the *Hirundinidæ*, on their equatorial movement, has also been unusually early, no doubt strongly influenced by the low temperature of the season.

Before the 1st of September the most of the Warblers had disappeared, a few individuals of *Sylvia trochilus* alone remaining till the 8th or 10th of that month, and after the 20th of Septem-

* W. De Haan, in Siebold's Fauna Japonica. Crustacea, Part ii. p. 36; quoted in the Magazine of Zoology and Botany, No. 5.

ber, more than a month before their accustomed time, the *Chimney swallows* and *Martlets* had entirely disappeared. It is worthy of remark, that the Crossbill, whose summer migrations extends to higher latitudes, were observed in Northumberland as late as the 2nd of May, at which time the eggs in the ovary of the female were some of them as large as peas.

The Fieldfare, (*Merula pilaris*,) one of our winter visitants, arrived in large flocks on the 24th and 25th of the present month, being a fortnight or more before the average time of its appearance.

An extraordinary deficiency of the insect tribe, particularly Coleoptera and Lepidoptera, has been generally noticed throughout the north of England and Scotland during the spring and summer just passed.*

ON THE CHANGES WHICH THE OVA OF FISHES UNDERGO PREVIOUS TO THE EXCLUSION OF THE EMBRYO.

In order to make observations on this subject, Von M. Rusconi repaired to the lake of Como early in July, being assured by the fishermen that both Tench and Bleak deposit their spawn at that period. On the 10th of that month he procured some eggs from a female tench, (Cyprinus tinca, Lin.), and placed them in a glazed earthenware vessel filled with water from the lake. They immediately sank to the bottom, and two or three drops of milt were expressed from a male fish upon them. The eggs were perfectly transparent, and of a greenish yellow colour, like that of olive oil. The milt was of the colour of milk, but much less fluid. In four hours after the fecundation, some of the eggs seemed to have lost their transparency on one side, and others by degrees assumed the same appearance, so that in twenty-four hours they had all become opaque, and their vitality was considered to be extinct. This the author supposed to have arisen from too large a quantity having been laid one upon another in the vessel, and he accordingly took a flat shallow dish, the bottom of which was covered with paper, and filled it with lake water. Some more fecundated ova were then placed in it, so that they did not come in contact with one another. In five hours he again remarked that some had become opaque on one side, and in twenty-four hours the same thing had occurred to nearly all. Some few, however, remained transparent, and these he raised gently from the dish, by means of the paper that was under them, and transfered them to glasses of water for farther observation, placing eight or ten in each; in six or seven hours after this operation, he saw by means of a microscope that the embryo had begun to move, and in twenty-four hours, (fifty from the moment of fecundation), the young fishes burst through their envelope.

* Magazine of Zoology and Botany, No. 5.

The experiment was again repeated in order to ascertain whether the ova of fishes undergo similar changes to those of the Batrachians, (vide Analysis of Muller's Archiv at p. 292,) and half an hour after the eggs had been placed in the dish, he lifted out those which remained transparent, and transfered them to glasses as before. It was now his object to destroy the vitality of some of them at each stage of their developement, in order to examine the progress that had been made, at leisure, and for this purpose he dropped into the water four or five drops of a mixture of one part of nitric acid and eight parts of water, which had the desired effect. This was applied at intervals of fifteen minutes during ten hours, and the following are the results obtained: Soon after the application of the milt, the ovum of the tench loses its spherical form, and swells out into the form of a pear. At the point where this swelling begins, it is surrounded with a cluster of microscopic globules, which before were spread all over its surface In half an hour, the pear-shaped excrescence is divided into four globules; these in a quarter of an hour more are subdivided into eight, and in a similar period into thirty-two, still remaining clustered together on the top of the egg. In ano ther half hour more globules appear, decreasing in size as they increase in numbers, till at length, from their minuteness, the part of the egg to which they are attached becomes almost as smooth as when they were undeveloped. The embryo fish now becomes discernible in the form of a whitish semitransparent speck, which is the rudiment of the vertebral column. The organization of the skin then gradually proceeds, and the embryo increases in length, coiled round the yoke, till the head becomes perceptible. In forty hours from the fecundation, the embryo tench first gave signs of motion, and at most, twelve hours later, it had freed itself from the skin of the egg. The fish is then two lines in length, and the blood has already acquired its natural colour. For some hours after leaving the egg, the young fry appear stupified; they lie on their sides and are unable to swim, until the swimming bladder is developed, when they immediately assume their proper position and their natural activity. The intestines are not fully developed until seven days after leaving the egg, when they begin to feed voraciously, and exclusively upon animal substances. The fry of the bleak, on the contrary, will only eat vegetable matter, at least during this early period of their existence. The temperature of the room in which these experiments were carried on, ranged from 72° to 77° Fahrenheit. The ova of the bleak are larger than those of the tench, and are for that reason preferable for the purposes of observation, besides being more easily procured. When they had reached the point at which the globules disappear, their vitality was no longer destroyed by the acid before-mentioned; but they were then placed upon a piece of black cloth, or more frequently

on a plate of polished silver in a glass of water, and the changes they underwent examined by means of a single lens. The author afterwards had an opportunity of watching a large shoal of Cyprinus Gobio in the act of spawning; he took up three or four pebbles upon which about a dozen eggs were deposited, and placed them in an earthenware vessel in his room, and paid no farther attention to them. About eight or ten days after, he observed four young fish swimming about with vigour, which were so transparent as not to be easily seen except in a dark-coloured vessel, and he appears to have met with none of the difficulties in rearing fish from the ova, which Her von Baer states to have so much impeded his observation.*

IRISH HARE, (LEPUS HIBERNICUS, YARRELL.)

By T. C Eyton.

Mr. Yarrell was, I believe, the first zoologist who observed that a considerable difference existed in the external character of the Irish and common hares. His account will be found in the proceedings of the Zoological Society for July 23, 1833, since which time Mr. Bell, in his History of British Quadrupeds, has described both of them, characterizing the Irish hare under the name of L. Hibernicus. I am not, however, aware, that any observations on the anatomical distinctions of the two species have been made public. With a view, therefore, of filling up the blank to a certain degree, this paper is written.

On placing the skeletons of the two species in juxtaposition, the most obvious distinguishing characters are the greater size altogether of the skeleton, the greater length of the lateral processes of the lumbar vertebra, the superior breadth of the scapula, the greater breadth of the ribs, the greater length of the humerus in proportion to that of the ulna, (which is scarcely longer than in the common hare,) together with the much larger size of the cranium and inferior maxillary bones in the Irish hare. These differences would probably distinguish it as a species distinct from the common hare, did no other characters exist.

In the numbering of the vertebræ and ribs they do not differ, except as to the caudal ones, which in the Irish hare are 13, and in the English 16; the sacral in both are 4, the lumbar 7, the dorsal 12, and cervical 7, making the total number in the Irish hare 43, and in the common hare 46.

The ribs in each species are twelve. The males of both species are smaller than the females in all their admeasurements. The intestinal canal is in the male of the Irish hare nearly two feet shorter than in the female. The following table will show the relative measurements in the female of each species, of some of the principal bones, and of the intestinal canal.

* Magazine of Zoology and Botany, No. 6.

	L. timidus, F.	*L. Hibernicus, F.*
Length of the intestinal canal from stomach to anus	14 ft. 1 in.	18 ft. 6 in.
Length from cæcum to anus	3 6	4 1
——— of cæcum	2 0	1 7
——— humerus	0 3 2-12	0 3 8-1
——— ulna	0 3 5-12	0 3 6-1
——— femur	0 4 2-12	0 4 5-1
——— tibia	0 4 8-12	0 4 10-1
cranium	0 3 3-12	0 3 7-1
Breadth of cranium	0 1 8-12	0 1 9-1
——— scapula	0 1 5-12	0 1 7-1

BRITISH MUSEUM.

A GRANT of 1,575*l.* has been voted by the House of Commons to enable the trustees of the British Museum to purchase the collection of shells belonging to W. J. Broderip, Esq., offered by him at the price of 1,500 guineas, and valued by Messrs. Turner and Sowerby, at 1,610*l.* 12*s.* 6*d.* Mr. Gray says: "The collection consists of nearly 3,000 specimens, and contains about 200 species, or very distinct varieties, that are altogether wanting in the already extensive collection of the British Museum. Such is the beauty of the specimens, in consequence of the great attention paid by Mr. Broderip to the purchase of none but the finest that could be procured, and so remarkable are the deviations in form and colouring in the several series of the more variable species, that nearly every individual specimen of the remaining portion will also be valuable to our collection, either in replacing a much inferior specimen, or as rendering more complete the series which we already possess. The duplicates to be displaced will be few, and will, for the reasons above given, be taken in every instance from our present collection, and not from among the specimens in the new acquisition. A very large proportion of the species contained in this collection, and wanting in the British Museum, are among the rarest shells that are known to exist, and many are absolutely unique."†

ON A PECULIAR STRUCTURE IN SHELLS; WITH SOME OBSERVATIONS ON THE SHELL OF SPHÆRULITES.

By John Edward Gray, F.R.S., &c.

IN a paper published in the Philosophical Transactions for the year 1833, I have described three kinds of structure found in such shells as had then come under my observation: but since that period Mr. G. B. Sowerby has given me an oyster-shell, and Messrs. Hudson and Bowerbank have lent me a fossil Sphærulite,‡ found in the chalk, each of which exhibits a form of

* Magazine of Zoology and Botany, No. 9. † Ibid.

‡ This appears to be the fossil which Mr. Mantell has indicated, but not described, under the name of Hippurites Mortonii. I say *appears*, for on going to Brighton to examine his specimen, I could not obtain

structure which I had not before observed, and which may be designated by the name of cellular.

The shells of this structure appear to increase in size in the same manner as others,—the peculiarity consisting in a deposition of one or more series of reticulations, leaving more or less numerous hollow polygonal cells between each of the lamina of which the shell is formed. The two shells which exhibit this formation show it in a very different state and degree of developement. In the Sphærulites, the entire parietes of the shell, (or at least the whole that is left in a fossil state, for some naturalists, as M. Deshayes and Desmoulin, believe that, from the form of the internal cast, the inner part of the shell is deficient,) are formed of series of continuous longitudinal and transverse ridges, leaving four-sided cavities, which are hollow in the specimens preserved in chalk, while in those that are found in limestone, they are filled up with infiltrated carbonate of lime. The concentric or transverse plates, which are best seen in a longitudinal section of the valves, and which represent the laminæ of growth, though remarkably regular in appearance, vary in the distance they are apart from each other. They are usually much closer together at the lips of the valves, or, in other words, when the animal has nearly reached its full growth; but sometimes we find them almost equally near in the middle of the cone, which may have been occasioned by some accidental check to the mollusc's regular increase about that period, and which removed or overcome again admitted the animal to progress at its ordinary rate.

When one of these shells is cut across in the axis of the cone, it is then found that the transverse laminæ are continued, and the cells which appeared regular in the longitudinal section, are seen to be rather irregular in size and form, but mostly hexangular or pentangular. They are deposited on these transverse plates, the next transverse plate or lamina of growth being laid over them; and as the cells of the next and every succeeding series are exactly similar in form and numbers, there necessarily results that uniformity which we have mentioned in the appearance of the longitudinal fracture, since the parietes of the cells of the different transverse laminæ appear in that fracture to be as much continuous with one another as the transverse ones really are. An analogous peculiarity exists in some shells of other structures. Thus in the Pinna, and other shells of a prismatic crystalline structure, the transverse prisms of which the outer coat of the shell is formed, appear to be continuous, though they are each formed of the many transverse laminæ of growth which are in

permission to have it taken from the case to compare it with that here described. It is certainly not a *Hippurites,* since it has neither the solid structure, nor the two internal longitudinal ribs of that genus. It is the shell figured as a fossil *Conia* by Mr. Hudson in Loudon's Magazine of Natural History, Vol. ix. p. 103.

succession deposited as the animal enlarges its size: and it is the same with the rhombic crystalline structure.

The outer surface of this shell, (Sphærulites,) is lamellar and hard, being formed by the agglutinated outer edges of the transverse laminæ of growth; and the inner surface of the cone is covered with a thin hard plate, which is marked with minute close concentric lines more numerous than the transverse plates of the parietes of the shell; and the plate is raised at the mouth of the cone a little above the surface of the lip, from which it is separated by a slight groove.

The mouth of the lower cone has a smooth concave lip as wide, or rather wider than the thickness of the parietes of the shell, and is marked with some radiating branched impressions, exactly like the impressions which one may suppose to be made by a blood-vessel; the slenderer and branched part being directed towards the outer edge of the lips.

A similar structure is to be observed in other species of this genus fossilized in limestone, but from the size of the cells in these, as appears when specimens of the same magnitude are compared, it is obvious that the whole formation was on a much smaller scale; and the cells are always filled with infiltrated carbonate of lime, which makes them appear solid, unless the surface of the specimen is slightly disintegrated, or the fracture is wetted and examined with a lens.

I can scarcely attempt to explain how the parietes of these cells are formed, nor determine if any fluid has, in their living condition, filled up the cavity between them, though it seems probable that they may have arisen from some peculiarity in the mantle of the animal, developed only when the new laminæ were about to be deposited, and not present or shrunk when the smooth upper surfaces of the lamina was formed, for it is evident, from the nature of the surface of some specimens, that the parietes of the cells are very gradually deposited on the smooth upper surfaces of the transverse plates of growth. The vein-like grooves above described do not seem to exert any influence over their form, for they are apparently not in any way connected with the distribution of their parietes, while yet they show that there must exist some peculiarity of the mantle to form such peculiar grooves.

These shells, and the Hippurites, have occupied considerable attention of late, on account of the difficulties which arise in determining their place in the animal kingdom; for although evidently bivalvular, yet they differ in several particulars from both the free bivalve shells of the Conchifera and the lamp-like bivalves of the Brachiopodes, not having the ligaments nor the apical umbones of the former, nor the numerous muscular scars so characteristic of the Crania, which alone resemble them in form among the latter. Two French authors have attempted to explain this difficulty. M. Defrance and others

having observed that the cast on which the genus Birostrites has been formed is always found in the cavity of these shells, and that as there is a space between the cast and the parietes of the shell, M. Deshayes concludes that the Sphærulites are conchifera provided with a toothed hinge and ligament, and allied to the genus Spondylus, the inner coat of which is lost in the act of fossilization. M. Desmoulins on the other hand believes them to be the shelly cases of a new class of animals of which he ventures to give a theoretical description, allying them to the Ascidia, believing the space between the cast and the shell to be filled up with the cartillaginous mantle of the mollusc. Unfortunately, none of the specimens, either from the chalk or the limestone strata, that have come under my notice, exhibit the internal cast as here described, but the specimens from the chalk certainly throw a doubt over both theories, for some have one or more oysters attached to the inner surface of their cavity, and others are pierced with minute branched worm marks exactly like the worm marks so common on the surface of existing shells. These facts prove that whatever may have been the structure of the substance which filled up the space said to have been lost in fossilization, (if any such substance ever was present in the species under examination,) it must have been lost before the shell was submitted to the fossilizing process, since otherwise the holes could not have been drilled into, nor the oyster shells attached to, the surface

A somewhat similar structure or appearance is to be observed in some Madrepores, especially in the spaces between the sinuous compressed stars of Meandrina, but in these zoophytes the longitudinal places are continuous and first deposited, and the thin transverse laminæ are interrupted and irregular, instead of forming the continuous plates which they do in the Sphærulites.

Some naturalists have compared the structure with that of Conia and the barnacles, but this must have originated in a very superficial view of the matter, for the valves of the barnacles are pierced with conical tubes gradually tapering from the base to the apex of the valve, and they are not cellular but tubular. The base of some barnacles is indeed cellular, and somewhat resembles the structure in question, but in them the longitudinal or rather radiating plates are continued, and the transverse ones, when present, unequal and disposed irregularly in different directions, showing even a more irregular cellular structure than in the Meandrinæ before referred to.

The second form of this structure is found in a recent undetermined species of oyster which I do not know in a perfect state. This shell exhibits the usual lamellar structure of its genus, but the laminæ of growth, which give the peculiar antiquated appearance to the common oyster, instead of being left free, are bent down so as to produce a nearly even outer sur-

face. When these laminæ are broken through, it is ascertained that the spaces under them are filled with a soft purplish spongy mass, composed of minute, rather irregular cells, placed perpendicularly between the plates. When these are near together, the cells extend from one plate to the other, but when they are wider apart, the cells are sometimes interrupted in the centre. They have somewhat the appearance of being casts of the interstices between the prisms of the prismatic structural shells, and are deposited in layers as the other parts of the shell are. I think they may be analogous to the opaque white chalky matter often found interposed between the laminæ of the common oyster, but here, though the chalky matter is sometimes seen on the inside of the exterior imbricate foliations, as the cellular structure is found in the shell under more immediate consideration, yet it is to be observed more abundantly, and commonly forming a convex spot in the disk of the cavity of the oyster, just beyond the scar of the large central adductor muscle; and sometimes also forming a raised broad belt near the outer margin of the valve, just within the free lamellar edge. The chalky matter is deposited in these places in a succession of thin plates, perhaps at the periodical interruptions to the animal's growth; and they are covered over with a hard and thicker calcareous plate, more dense and crystalline also in its composition.*

HYBERNATION OF ANIMALS.

By Dr. A. A Berthold.

ALTHOUGH many reasons have been assigned to account for the sleep of several of the Mammalia during winter, Otto seems to be the first who has attributed it to a peculiar organization of the vessels of the brain, and not merely to a decrease in the temperature of the air. [The result of his latest researches tends to show, that the *carotis cerebralis* in such animals is carried through the aperture of the stapes or stirrup bone.]

Dr. Berthold has kept for some time specimens of Myoxus avellanarius, some of which were captured when full grown, and others quite young in the nest. His observations upon them tend to confirm those of Pallas, Spallanzani, &c., and in some instances to correct the statements of other writers on the subject. The animals fell asleep whether they were kept in the open air or in a warm room Saissy states, that Myoxus glis did not fall asleep until the temperature was below 44° Fahr. Dr. Berthold's specimens of M. avellanarius were kept during the winter in a room, the temperature of which was never below 50°, usually from 59° to 63°, and sometimes as high as 68°, and they slept without intermission. Their sleep is more profound in a low than in a high degree of temperature, so that in the former case they may be shaken about for a long time without producing any effect, but in the latter, the shaking causes them

† Magazine of Zoology and Botany, No. 9.

to roll themselves up still more firmly, by pressing the head upon the breast, but even then they do not awake. Those kept in a warm room remained longer awake than others in a cold one. In October the latter began to sleep continuously, some, however, awoke every day for some time longer and took some food. Towards the middle of December their sleep became deeper and deeper, and from that time to the middle of March they only awoke two or three times at most. The sleep of those which were kept in a room of ordinary warmth was modified by sudden changes of weather, until it reached the most profound state. When snow or frost was coming on they slept more soundly; as the weather became milder they were more active, and often awoke for several hours, when they took some food, which they digested completely and then relapsed into sleep. Whenever they awoke under any of these circumstances, their character as nocturnal animals remained constant, as it always happened in the evening or during the night. When old ones, and their young which had not passed a winter, were kept together, the former fell asleep first, as the latter, not yet having attained their full growth, required more food, and their sleep was retarded by the calls of hunger. The temperature of the animals during their sleep is regulated very much by that of the surrounding air. For instance, when a thermometer placed in the saw-dust which formed their nest indicated 36°, the heat of their bodies was 37°. At other times, the heat of the saw-dust and the animals were respectively,

38°	....	50°	54°	....	53°
60	....	58	63	....	63
56	....	54	58	....	61

Thus it appears that the temperature of the animals is sometimes higher, and at other times lower, than that of the surrounding medium. In order, however, to prove this more clearly, the nest was placed in the open air at night, when the thermometer stood at 23°, and the respective temperature of the animals and the nest was taken down every half hour. The result showed that the body is more slowly susceptible of change than the saw-dust, but that when the heat of the day is greatest, that of the animal soon surpasses it, and is longer in cooling down again. The heat of different individuals, however, is subject to variation. They are also so constituted, that they remain some degrees above 32° when the external air sinks below that point. In times of extreme cold, unless they are surrounded by a nest of warm materials, death ensues, and the slowness with which their heat is lowered to that of the air is no doubt a provision of nature to provide for their safety in such cases.

The author's view of the question is, that hybernation does not proceed from too great a degree of cold, nor from want of nutriment, (since animals fall asleep though kept in a warm place and supplied with abundance of proper food,) nor yet from the

want of power to retain a due supply of heat whilst the temperature of the air is becoming lower; but he regards it as a part of the great system of nature, which exhibits a deficiency of vital energy in every branch of the animal and vegetable world at stated periods. This condition shows itself in some animals when instinct leads them to provide receptacles against the approach of winter, either singly or in societies, then in a state of inactivity, and a desire to sleep, and lastly in a complete suspension of the action of the nerves, the circulation, the digestive organs, &c. or, in other words, which he calls the condition of "vita minima." This condition is represented amongst the Mammalia which do not hybernate by the shedding of fur, &c.; amongst birds by moulting, and by migrations; by concealment and torpidity amongst the Amphibia and the Invertebrata: and in the vegetable kingdom by the ripening of seeds, the falling of leaves, branches, &c. The same cause will account for the torpidity during summer of the Tanrec of Madagascar, of the crocodile, and of various serpents in South America; in short, whilst the heat of the sun in tropical climates produces periodically a diminution of vital energy, the absence of that heat in our latitudes produces similar effects, as shown by the torpidity or "vita minima" of the animals under consideration, both being parts of a comprehensive and uniform system pervading every branch of animated nature.*

SINGULARLY FORMED ORTHOPTEROUS INSECTS.

By George Robert Gray, Esq.

CYLINDRODES *G. R. Gray.*

HEAD small, of a long triangular shape, with the angles rounded. *Antennæ* (only a few basal joints remained in the specimen) apparently moniliform. *Labrum* small, shaped like a horseshoe. *Mandibles* small, strongly dentated. *Eyes* very small. *Palpi* with the last joint truncated, somewhat rounded, and slightly enlarging towards the tip. *Body* very long, cylindrical; the thorax occupying more than a third of its whole length, distinctly dividing into prothorax, mesothorax, and metathorax. The first is the longest, and cylindrical; the last two are nearly equal. *Abdomen* of eight joints, the last the largest, with the apex rounded, depressed and margined above, and without any caudal appendages. *Anterior legs* moderately strong, compressed and dentated in front; the *tarsi* composed of two long slender joints without a claw. *Posterior legs* very short, and received in cavities on each side of the body. The cavities which receive the second pair of legs occupy the spaces between the mesothorax and metathorax; while the third pair are contained in the interval between the metathorax and the first joint of the abdomen. The legs are much compressed. *Femora* broad and armed at the apex, with a blunt spine, serving as a guide to the tibia, when in the act of being drawn beneath them. *Tibiæ* broad, compressed, and strongly armed with a short spine at the tip. *Tarsi* biarticulated, ciliated beneath, and furnished with a very small claw.

* Magazine of Zoology and Botany, No. 11.

C. Campbellii *G. R. Gray.** (fig. 1.)

Smooth; head, forelegs, and last joint of the abdomen dark brown; thorax reddish brown; abdomen, (except the last joint,) and the two posterior pairs of legs, yellowish brown, with a tinge of darker colour.

Brought from Melville Island, on the north coast of New Holland, by Major Campbell; who informed me that he was unable to keep a single plant in his green-house on account of the ravages of this insect. It bores in their stems; and the withering of the plants alone betrays the secret work of the spoiler. Its form is admirably adapted for its mode of life. The power which it has of drawing its legs at pleasure into the cavities at the sides of the body enables it to assume a shape almost perfectly cylindrical; while the short blunt spine at the end of the tibia, being protruded, keeps the insect fast when it is engaged in boring. The name given by the colonists to this insect was the wireworm

I may here mention, that a species of the genus Gryllotalpa is also found in New Holland, but of a small size. Specimens have also been brought from Brazil, India, China, and Egypt.

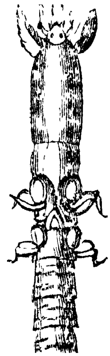


Fig. 1.

The group to which I am now desirous of directing attention has been sadly neglected by entomologists, although it contains, as is here exemplified, some very singularly formed species, which are well worthy of notice. Those to which I am about to refer are included under my subgeneric name of

Anostostoma.

Antennæ much longer than the body, multi-articulate, setaceous. *Labrum* large, crescent-shaped. *Head* very large, globose above, somewhat elevated into a ridge between the antennæ, with three ocelli at the base; the eye prominent, and somewhat crescent-shaped. *Mandibles* long, porrected in some, horizontal, strong, dilated and dentated at the tip. *Trophi* much exposed. *Mentum* long, somewhat narrow, but rather dilated near the tip. *Labial palpi* slender, basal joint short, second shorter than the third, which is much more slender than the others, with the tip membranaceous and dilated. *Maxillary palpi* very slender, long, with the tip ending in an acute spine; first and second joints equal to one another, the third and fourth also equal, the fifth rather longer than the fourth, with the tip membranaceous and slightly dilated. *Prothorax* as long as broad, with the margin somewhat rounded. *Abdomen* long, broad, with short caudal appendages, which are hirsute. *Legs* long, especially the hind ones; the *tibiæ* of all strong, spinous. *Tarsi* four jointed. Apterous in both sexes.

* Figured, but not described, in *Griffith's Translation of Cuvier*, pl. 131.

A. AUSTRALASIÆ *G. R. Gray.* (fig. 2) Ferruginous; abdomen variegated with yellow; legs yellow; tip of the mandibles black; those of the male porrect; of the female horizontal.

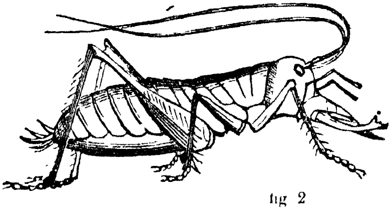


fig 2

The two specimens examined were brought from the interior of Australia, about 300 miles up the country. I can give no information about its habits, as no remarks were sent with them. The species is allied to Locusta spinosula and L pupa; which form the genus Bradyporus of Latreille. Both are inhabitants of Africa. From the great length of the antennæ, and in possessing anal appendages, it appears to be allied to the crickets, but, as the insect has four joints in all its tarsi, I have placed it with the locusts.

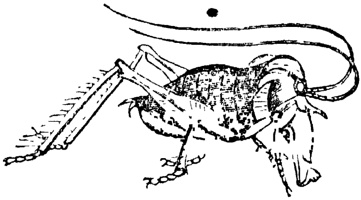


fig. 3.

In the same subgenus must be placed a species somewhat similarly formed, long since figured by Herbst, (*Nat freun. Berl. Neue Schriften*, vol. iv.), under the name of Locusta monstrosa. (fig. 3) This has never been referred to by any entomologist since its publication. Its peculiarities are, that the mandibles (of the male) are horizontal and long, with the apex dentated and curved, so that the two ends meet; and the head is peculiar from having a wing-like projection on each side, with the margins dentated. This insect is supposed to come from Surinam; and I would propose to call it A Herbstii, in honour of its first describer.

Another very singular insect will be found in Stoll's work on Cigales, under the name of Gryllon aquatique cornu, which appears to come near the foregoing, though the form of the head is totally distinct. It is very long, truncate, with two long acute curved horns, projecting forwards over the lip: the latter is very large, pyriform, covering the mandibles: the palpi are filiform. For further characters, I must refer to the figure of this curious insect, with the name of Henicus Stollii. (fig. 4.)*

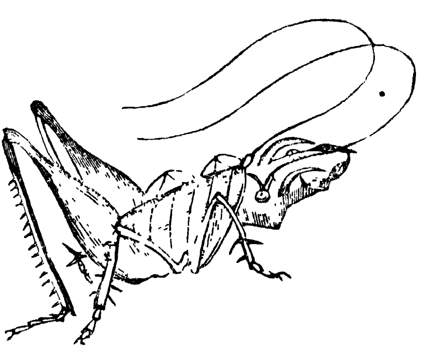


fig 4.

* Magazine of Natural History, No. 3.

GROWTH OF POLYPIDOMS.

Dr. George Johnston observes: There are many facts which prove that the growth of polypidoms is very rapid, but not more so than might be anticipated when it is remembered how vast is the number of polype architects; and no sooner is a new branch extended than it becomes almost simultaneously a support of new workers, which, with "toil unwearyable," add incessantly to the materials of increase. Their duration is various: some have only a summer's existence, as Campanularia geniculata; many are probably annual, and the epiphyllous kinds cannot at most prolong their term beyond that of the weed on which they grow; but such as attach themselves to rocks are probably less perishable, for their size and consistency seem to indicate a greater age: it is thus with the Tubulariæ and some of the compound Sertulariadæ.

But the life of the polypes considered abstractedly is probably in no instance coetaneous with the duration of the polypidom, for the lower parts of this become, after a time, empty of pulp and lifeless, and lose the cells inhabited by the polypes, which, in an old specimen, are to be found in a state of activity only near the summit, or on the new shoots. The Thuiaria thuja affords a remarkable example of this fact; the branches which carry the polypes dropping off in regular succession as younger ones are successively formed, so that the polypidom retains, throughout its whole growth, the appearance of a bottle brush, the naked stem and the branched top being kept in every stage in a due proportion to each other. Sertularia argentea, Plumularia falcata, &c. are subjected to the same law,—the primary polypiferous shoots being deciduous, so that in them also the stalk becomes bare, while the upper parts are graced with a luxuriant ramification loaded with tiny architects. But in our eagerness to generalize, let us not forget that there are some species, as Sertularia pumila, abietina, &c., in which this process of successive denudation is not observable, perhaps, however, because of their form, which is not of a kind to be altered by it, and hence unnoticeable, or because the duration of the whole is too fugitive to permit the law to produce a visible effect.

There are facts which appear to prove that the life of the individual polypes is even more transitory than their own cells; that like a blossom they bud and blow and fall off or are absorbed, when another sprouts up from the medullary pulp to occupy the very cell of its predecessor, and in its turn to give way and be replaced by another. When speaking of flexible corallines, Lamouroux says, "Some there are that are entirely covered with polypi through the summer and autumn, but they perish with the cold of winter: no sooner, however, has the sun resumed his revivifying influence than new animals are developed, and fresh branches are produced upon the old ones." * Of the Tubularia

* Corall. Flex. p. 16.

indivisa, Sir John G. Dalyell tells us that "the head is deciduous, falling in general soon after recovery from the sea. It is regenerated at intervals of from ten days to several weeks, but with the number of external organs successively diminishing, though the stem is always elongated. It seems to rise within this tubular stem from below, and to be dependent on the presence of the internal tenacious matter with which the tube is occupied. A head springs from the remaining stem, cut over very near the root; and a redundance of heads may be obtained from artificial sections, apparently beyond the ordinary provisions of nature. Thus twenty-two heads were produced through the course of 550 days, from three sections of a single stem."* The observations of Mr. Harvey on the same, or a very nearly allied, species of zoophyte confirm the experiments of Sir J. G. Dalyell, so far as these have reference to the deciduousness of the polypes and their regeneration;† and it seems to me not altogether unwarrantable to infer a like temporary existence and revival in those of the Sertulariadæ from a reflection on the experiments of Mr. Lister,—incomplete certainly, but which prove that under certain circumstances their polypes disappear by a process of internal absorption,‡ and under convenient circumstances would have been renovated, as I have witnessed in similar experiments.§

* Edin. New Phil. Journ. xvii. p. 415.

† "The most singular circumstance attending the growth of this animal, and which I discovered entirely by accident, remains to be mentioned. After I had kept the clusters in a large bowl for two days, I observed the animals to droop and look unhealthy. On the third day the heads were all thrown off, and lying on the bottom of the vessel; all the pink colouring matter was deposited in the form of a cloud, and when it had stood quietly for two days, it became a very fine powder. Thinking that the tubes were dead I was going to throw them away, but I happened to be under the necessity of quitting home for two days, and on my return, I found a thin transparent film being protruded from the top of every tube: I then changed the water every day, and in three days time every tube had a small body reproduced upon it. The only difference that I can discover in the structure of the young from the old heads, consists in the new ones wanting the small red *papillæ*, and in the absence of all colour in the animal."—Proceed. Zool. Soc. No. 41. p. 55.

‡ Phil. Trans. 1834. p. 374, 376.

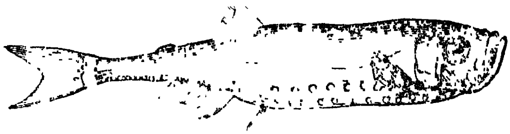
§ On Saturday, May 28th, 1837, a specimen of Campanularia gelatinosa was procured from the shore, and after having ascertained that the polypes were active and entire, it was placed in a saucer of sea water. Here it remained undisturbed until Monday afternoon, when all the polypes had disappeared. Some cells were empty or nearly so; others were half filled with the wasted body of the polype, which had lost, however, every vestige of the tentacula. The water had become putrid, and the specimen was therefore removed to another vessel with pure water, and again set aside. On examining it on the Thursday (June 1st) the cells were evidently filling again, although no tentacula were visibly protruded, but on the afternoon of Friday (June 2nd) every cell had its polype complete, and displayed in the greatest perfection.

Had these singular facts been known to Linnæus, how eagerly and effectively would he have impressed them into the support of his favourite theory! Like the flowers of the field the heads or "flores" of these polypidoms expand their petalloid arms, which after a time fall like blighted blossoms off a tree;—they do become "old in their youth," and rendered hebetous and unfit for duty or ornament by age or accident, the common trunk throws them off, and supplies its wants by ever-young and vigorous growths. "Admiranda tibi levium spectacula rerum." The phenomena are of those which justly challenge admiration and excuse a sober scepticism, so alien are they to all we are accustomed to observe in more familiar organisms; but besides that faithful observation renders the facts undeniable, a reflection on the history of the Hydra might also have led us to anticipate such events in the life of these zoophytes "Verily for mine owne part, the more I looke into Nature's workes, the sooner am I induced to beleeve of her even those things that seem incredible." *

NOTICE OF THE FOURTH OCCURRENCE OF THE ARGENTINE, (? Scopelus Humboldtii, *Yarr.*) UPON THE BRITISH SHORES.

By Dr. W. B. Clarke. With additional Remarks, by W. Yarrell, Esq.

I BEG leave to transmit a sketch and description of a species of Argentine, which I obtained upon the shore of the Firth of Forth, at Portobello, in April, 1833:



(The Argentine, (? Scopelus Humboldtii, *Yarr.*)

I discovered this highly elegant little fish, whilst looking amongst the various bodies cast up by the water, and observed it lying entangled in some sea-weed, which had been accumulated in masses, and left by the retiring tide. The fish was dead, but from its freshness could not have long been so.

In the Animal Kingdom of Cuvier, translated by Griffith, we have the following description of the genus:

Scopelus, Cuv. *Serpes* of Risso.

"Mouth and gills extremely cleft; the two jaws furnished with very small teeth: the edge of the upper entirely formed by the intermaxillaries: the tongue and palate smooth—Their muzzle is very short and obtuse: there are nine or ten rays to the gills, and besides the usual dorsal, which corresponds to the interval of the ventrals, and the anal,

* Magazine of Zoology and Botany, No. 10.

there is another very small one behind, in which the vestiges of rays are perceptible"

"These fishes are caught in the Mediterranean, intermingled with the anchovies, and they are there called Melettes, as are other small fishes. One of them, the *Serpes Humboldtii*, Risso, pl x. fig. 38, is remarkable for the brilliancy of the silvery points which are distributed along the body and tail."

Then in a note we have, "I believe this fish to be the pretended *Argentina Sphyræna* of Pennant's Brit. Zool. No. 156, therefore it should be found in our part of the Atlantic."

Besides the *Scopelus Humboldtii*, which probably is identical with the species under description, there are two other species, viz *Serpes* (*Scopelus*) *crocodile*, Risso, p. 357; and *Serpes* (*Scopelus*) *balbo*, Id. Ac. des Sc. de Turin. tome xxv. pl. x. fig. 3.

Mr. Yarrell, in his invaluable work upon the British Fishes, states, "Pennant, and the Rev. Mr. Low, of Orkney, appear to be the only British observers who have met with, on our shores, examples of this brilliant little fish, which Cuvier considers as belonging to the genus *Scopelus*." "Pennant's specimen was taken in the sea near Downing, in Flintshire. Mr. Low's fish was brought to him by a boy, who said he found it by the edge of the water, amongst sea-weed. The receipt of an additional portion of MS. recently confided to me by William Walcott, Esq. furnishes a notice, written by his father, of a third instance of the occurrence of the Argentine, which was found stranded on the shore near Exmouth."

Pennant's description agrees, in many respects, with my fish; but as the figure contained in Mr. Yarrell's work, (which was taken from Pennant's), differs very materially about the head and tail, although it resembles it in the form of the body, I have sent an exact figure of my own specimen, to show the precise form of the bones of the *opercula* and sides of the head; together with a full description: which may assist future observers in determining whether more than one species visits our shores. If Pennant's figure be an exact representation, the fish it was taken from was certainly a different species to the one under description.

Pennant describes his as follows, viz. "Length, two inches and a quarter: the eyes large, *irides* silvery; the lower jaw sloped much: the teeth small: body compressed, and of an equal depth almost to the anal fin: tail forked: back was of a dusky green: the sides and covers of the gills as if plaited with silver: the lateral line was in the middle, and quite straight: on each side of the belly was a row of circular punctures, above them another, which ceased near the vent."

My specimen would correspond with the above, except the following, viz. Length 1 inch 15·16: the back of a dense blue-black, presenting, in certain lights, a brownish tinge: lateral

line central and straight, but inclining upwards, at about its anterior sixth, towards the upper angle of the *operculum.*

The number and arrangement of the *guttæ* in the specimen under consideration, are as follows; viz. On each side, upper series between *os hyoides* and origin of pectoral fin, five; upper abdominal series between base of pectoral and a spot perpendicularly over the ventral, nine; lower abdominal series, from a spot perpendicularly beneath the posterior margin of orbit, to base of ventral, twelve; between base of ventral and commencement of anal, six; the two anterior directed downwards and backwards; the four posterior forming an arch from a little above the second *gutta* to the commencement of the anal fin: one large *gutta*, in a line with the upper abdominal series, is placed slightly anterior, but above the commencement of the anal fin: between the anterior commencement of anal and base of caudal twenty-four; but between the eighth and ninth from the caudal fin, there is a space where a spot appears to have been obliterated.

About midway between the anterior commencement of the dorsal and base of caudal, but rather nearer the latter, there is a slight elevation, where, apparently, the fleshy fin has its origin; but in the specimen under description, it is scarcely perceptible, being, even with the aid of a lens, only like a slight membraneous ridge.

The formula of the fin rays appears to be D. 9. P. 17. V. 8. A. 20. C. 18.
Mr. Yarrell's formula is......... ..... D. 9. P. 17. V. 8. A. 15. C. 19.

Mr. Yarrell remarks: "the figure of this fish, referred to in Risso's work, represents the anal fin as containing many more rays than are represented in the figure by Pennant." The fish obtained by me possesses more anal rays than Pennant's would appear to have had, judging from the figure which he has published.

Length of head compared with whole length of fish, as one to four: diameter of eye to length of head, as one to three: first dorsal fin commences midway between end of nose and tail: depth of body to whole length of fish, as one to five and a half: nostrils double, situated in a depression midway between the eye and centre of intermaxillary bone. The *operculum* is extremely large, and appears to be developed at the expense of the *pre-operculum*, which is very small, and joins the former by a straight movable suture, running in a line perpendicularly downwards, from the posterior margin of the orbit; it forms an obtuse-angled triangle, with the obtuse angle pointing downwards and backwards: the sub-orbital bone occupies nearly the anterior inferior half of the orbit, and is of a beautiful argenteous lustre, like the *operculum.* There are five oval spots, forming a fan-shaped figure, occupying the space between the anterior edge of the superior maxillary bone, and the anterior inferior angle of the *pre-*

operculum, beneath the sub-orbital bone, and distinctly seen through the transparent intermaxillary bone, which is very large. There is one *gutta* upon the *pre-operculum*, at its anterior inferior angle, and the appearance of another at the anterior inferior angle of the *sub-operculum*: there is no appearance of branchiostegous rays whilst the *opercula* are closed.

The sides of this elegant little fish are of the most resplendent argenteous lustre; the *guttæ* are of a dense opaque white, and round their margin, especially along the sub-caudal series, there is a steel-blue tinge, giving that part of the body a very beautiful appearance. The upper abdominal series have an arched appearance, from this tinge not being continued round the inferior margin of the *guttæ*. The back of the specimen under description, which has been in spirits ever since its capture, is of a dense blue-black, presenting, in certain lights, a brownish tinge.

From specimens of this fish having been found in the above localities, viz. in the sea near Flintshire, on the shore in Orkney, in Devonshire, and lastly, in Edinburghshire, we may infer that it is generally, although sparingly, diffused through the British seas. Probably, ere long, we may hear of other examples of its occurrence upon our shores, or in our seas; for I am convinced, that from the admirable character of Mr. Yarrell's work, it will have the effect of exciting such an interest in the inhabitants of the boundless deep, that many interesting facts respecting the Ichthyology of our seas will soon be brought to light, which, but for such a publication, would have remained unrecorded, perhaps unnoticed.

Upon this specimen, Mr. Yarrell observes: The minute size of the fish renders it, I think, extremely probable, that the example obtained by Dr. Clarke at Portobello, the one noticed by the Rev. Mr. Low, as found in Orkney, and a third specimen taken still farther north, now preserved in the museum at Bergen, and described by Professor Nilssom, in his Prodromus, will eventually prove to be distinct as a species, from the examples found by Dr. Walcott, and Pennant, on our south coast, and in the west; the more so, because I learn from the Prince of Musignano, who is now in London, that the species of the genus *Scopelus*, or of genera very closely allied, are much more numerous than have hitherto been supposed. In a new History of the Fishes of the Mediterranean, written by the Prince of Musignano, which it is hoped will soon be put to press, no less than thirteen species are described, as inhabiting that sea. The extensive resources of this gentleman, and his great acquirements as a naturalist, cannot fail to render this intended publication equally interesting and valuable.*

* Magazine of Natural History, No. 13.

ZOOLOGY OF AFRICA.

Dr. Andrew Smith has lately returned from an expedition, undertaken to explore the interior of Southern Africa, and that he has brought to this country the whole of his collections in Natural History, which are now publicly exhibited in London. In the published catalogue of part of this collection there are the names of 62 mammalia, and 339 birds: there is besides an extensive series of drawings, MSS., &c., with other materials fully to illustrate the districts traversed; and in furtherance of his plan Dr. Smith is about to commence printing a work, to be entitled "The Zoology of Southern Africa," embellished with highly finished plates, executed from the original drawings. On the authority of an individual on whose judgment we can rely, we are able to say that the materials are most valuable, and the drawings full of character and interest. The government has granted 1,500*l*. to assist in defraying the expenses of the publication, "In consequence of this," says the editor of the Magazine of Natural History, "an arrangement is being made with the intended publishers (Smith and Elder, Cornhill), by which the public will obtain the work at one-fourth or fifth of the actual cost price, the government grant defraying the whole expense of engraving the plates."*

INSECTS INFESTING BOOKS.

At the British Association, the Rev. T. W. Hope read a letter from Sir Thomas Phillips on the best method of destroying insects which infest books and MSS. Sir Thomas found the wood of his library attacked by Anobium striatum, particularly where beech had been introduced, and appeared to think that this insect was much attracted by the paste employed in binding. He recommended as preservatives against their attacks spirits of turpentine and a solution of corrosive sublimate, and also that the latter substance should be mixed with the paste. In some instances he found the produce of a single impregnated female sufficient to destroy a book. Much unimportant discussion followed the reading of this letter, regarding the best manner of preventing the Coleoptera and their larvæ from destroying objects of natural history. Turpentine and spirit of tar were recommended; but Mr. Gray stated that the only method pursued in the collections of the British Museum was an abundant supply of camphor, with attention to keeping the rooms dry, warm, and well ventilated. Mr. Macleay stated that it was *acari* only which fed on the paste employed in binding books, while it was the larvæ of the Coleoptera only which pierced the boards and leaves. He also recommended dryness and ventilation.†

* Magazine of Zoology and Botany, No. 10. † Ibid.

POISONOUS BUG OF PERSIA.

At the British Association, Dr. Traill exhibited specimens of the *Argas Persicus*, the poisonous bug of the Mianneh of Persia, and made some short verbal remarks regarding it. The bite was said to create a fever similar to that of typhus, and it was considered fatal to sleep in some of the villages near which it abounded: Mr. Macleay considered that the specimens exhibited were not true insects, but belonged to the family of the Arachnoideæ, and that among them there were two genera, *Argas* and *Ixodes*. He also did not consider the bite so fatal as stated by Dr. Traill, but thought the inflammation might be produced by the serrated rostrum remaining in the puncture; and remarked that, in the Island of Cuba, there existed another poisonous insect belonging to a similar family, which attacks the horses, producing great pain and irritation, but he added, that the horses thus attacked were always considered to be those in best health and condition. Dr. Traill persisted in his opinion.

Mr. Haliday exhibited engravings, (from the Suites des Buffon) of *Argas Persicus* and *ixodes*, in illustration of the subject. Mr. Macleay remarked, that the term *bite*, which was employed when describing the wound inflicted by this animal was improper, being produced by the insertion into the skin of a serrated rostrum, which produced great inflammation. He also remarked that the history of this genus was remarkably curious. In Cuba oxen were sometimes covered with them, and when they had sucked their fill, the serrated rostrum breaks off, and the creature makes its way to the nearest stone, under which it may then be found. When brought home, thousands of eggs would be found issuing from the broken rostrum. He, however, did not pretend to say that the eggs were not impregnated by the usual canal, but that he had never seen them produced in any other way than from the opening formed by the abrasure of these parts, which, when the animal became so full, seemed to serve the common purpose of an intestinal and generative opening. These eggs produced a hexapod larva, the young form of the great division Arachnoideæ, of which the Acari are the types.*

CHANGES IN CRUSTACEA.

At the British Association, Mr. Macleay read a communication from Captain Ducane of Southampton, on some marine animals. In laying this communication before the Section, he stated, in explanation of the objects of the paper, that, while Mr. Thompson had observed that the craw fish underwent metamorphoses from the young to the perfect state, Rathke of Berlin maintained the reverse, which would be a remarkable fact if proved, to find that a change took place in long-tailed crustacea, while none had

* *Magazine of Botany and Zoology, No. 10.*

been observed in the Brachyurine division. He felt inclined to support Mr. Thompson's opinion, considering that gentleman an accurate naturalist, and he could scarcely think that one who had observed the remarkable fact of the cirrhipeds being locomotive and free in their young state, would now be mistaken. The letter about to be read confirmed his views, and showed an instance of an individual, who had not previously attended to natural history, observing and proving the curious tranformations which are puzzling our professed naturalists. Captain Ducane, Mayor of Southampton, had his attention lately directed to marine animals. He found specimens of what at the time he considered the common prawn (palemon serratus) in the ditches of a fen where the tide occasionally entered, and the water was brackish. These were loaded with eggs, and when put into fresh salt water, it was soon afterwards filled with small diaphanous creatures; very different in form from the parent animals. He was not, however, able to keep them more than three days alive—the parent only five or six. Drawings of this animal and the young were shown to Mr. Macleay, who discovered at once that it was not a *Palemon*, but a species of some allied genus, perhaps *Crangon*, and on comparing Captain Ducane's drawings with the figure of Mr. Thompson, copied from Slabber's work, found them very similar, and almost identical; and this fact he considered went very far to prove the confirmation of that gentleman's observations.

Dr. Richardson hinted at the possibility of these young animals being parasitical in the eggs of the Crangon, but Mr. Macleay considered it impossible that every egg should contain a parasite. Mr. Hope remarked that Zoe had been found parasite on Beroe, while Mr. Macleay stated that he had found the Decapod crustacea parasitical in the Gulf stream, but could not perceive the smallest ground for believing that the young alluded to in Captain Ducane's letter could be animals of this description.*

INSECTS INFESTED WITH PARASITES.

At the British Association, the Rev. F. W. Hope read some observations on the genus *Filaria*, confining his observations principally to those species which infest insects, and exhibited a specimen of *Steropus Ethiops*, with the parasitic Filaria protruding. He considered that the first attack was made in the larva state, and that in this respect they, to a certain degree, resembled the Ichneumons, and might among Coleopterous insects, assume their part, and be a wise provision for controlling the exuberance of species. All the insects hitherto recorded as infested with these parasites, live in moist places, some of them are entirely aquatic. One species he discovered in a species of

* Magazine of Botany and Zoology, No. 10.

Phryganea, though he had not succeeded in detecting it in their larvæ; among the Lepidoptera he had not discovered any. A list of forty species of insects, which were infested with Filaria, was laid before the meeting. Rudolphi considered all the species to be identical; but in this assertion Mr. Hope could not agree, having detected several among the Coleoptera, while that in the Phryganea were distinct from all; and he considered that each species, or at least each genus, possessed a species peculiar to it. Several distinct forms even seemed to exist, while the distinction between Gordius and Filaria had not yet been sufficiently marked, and he would now propose that *Filaria* should be restricted to the form exhibited by the common Guinea worm (F. Medinensis,) and concluded by recommending attention to the species which infested the animals composing our own Fauna. Mr. Duncan asked if Mr. Hope had paid sufficient attention to the different species to say that they were distinct in each. Mr. Hope said he had, and that he considered they would afford the means of distinguishing the closely allied animals, and that those infesting the higher orders were distinct from the insect parasites. Mr. Macleay considered the paper a most valuable one, and thought that each insect contained its peculiar species. He could add to the list on the table, and possessed a spider which contained a Filaria. In an article in the Bibliotheque Universelle, a Filaria is recorded from a specimen of Gryllus. The tenacity of life was also alluded to: that belonging to the Gryllus had remained dried up for several weeks, and when placed in water again revived. Mr. Hope concurred in these observations, and stated that he believed the specimen on the table was yet alive, having made various contortions since the insect had been set up.*

ON THE DEVELOPEMENT OF THE DECAPODES.

By H. Rathke †

A PRIZE question having last year been proposed by the Natural History Society of Haarlem, relating to the developement of the ten-footed crustacea, and more especially the crabs, I am induced to offer a few remarks on the subject.

As is already known to you, I formerly endeavoured to prove, in my account of the river crab, that this animal, when it leaves the egg, is so far perfected in its form, that it has to undergo no farther important metamorphosis until it reaches maturity. Some years afterwards, Thompson advanced the opinion that the *Decapodes* living in the sea, as, for examples, the crabs and even the lobster, leave the egg in a very imperfect state, and that they then present a strong resemblance in this respect to the Zoea; thus leading to the inference that, if my observations regarding the river-

* Magazine of Zoology and Botany, No. 10.

† From "Muller's Archiv für Anatomie, Physiologie, und Wissenschaftliche Medicin." 1836.

crab were correct, the latter would present a great anomaly among the *Decapodes.* In consequence of this, the Haarlem Society, much to the satisfaction of all those who have taken an interest in the history of the developement of animals, have been induced to offer a prize for the best account of the circumstances relating to developement which are presented by crabs after their departure from the egg. In this state of matters, I wish to say a few words, which may assist in an examination of Thompson's view, and perhaps also furnish hints as to the points that more especially demand attention in the determination of the question.

About three years ago, during my residence, for a spring and a summer, on the shores of the Black Sea, I examined the developement of about fourteen species of Crustacea belonging to very different orders; and among others the Eriphia spinifrons, a new species of Palæmon, and a new species of Crangon. During the present year, I continued my investigations at Dantzic by examining the Palæmon squilla. I hope to be able in a few weeks to present to the public the work in which an account is given of all my observations. I found, in regard to all the above-mentioned *Decapodes*, that, at the last period of their uterine life, they possessed just as many tentaculæ—parts of the dentary apparatus—and bones, as the old individuals of the same species; further, that all these organs present the same relative positions, at least in regard to their attachment; and that all these have the same combination and similar forms as in the old individuals. It is only the proportions which, in those parts present not inconsiderable differences in the more advanced embryo and the old individual. Thus, for example, in the Eriphia spinifrons, when it is about to leave the egg, the antennæ are in proportion longer, but the claws shorter and much more slender, than when the animal is grown. Also the tail and the eyes, considered as a whole, are formed long before these crustacea leave the egg, and are similar to the same organs in the fully grown animal—differing only in their proportions. The eyes are in proportion much larger, especially in the Eriphia, in which, during the last half of its uterine life, they attain an enormous size; but, of the two principal parts which can be distinguished in them, it is the outer half or the real eye that is particularly remarkable for its size; as to the tail, it consists, in the more advanced embryo, of just as many segments as in the grown animal, and is provided with a fan, not only in the species mentioned as having long tails, but even in the Eriphia. I cannot distinctly state the number of parts composing the fans of the Eriphia; but in the embryo of the Palæmon squilla the fan consists of five leaf-like portions. With regard to the relations of the dimensions, it appears, as Cavolini formerly remarked of another crab, that the tail of the more advanced embryo, of the Eriphia spinifrons, is much longer than in the grown animal, but still very small, and nearly equally broad, and similarly formed, as in the long-tailed *Decapodes.* In the more advanced embryo of the Palæmon and Crangon, on the contrary, the tail is comparatively not so thick and fleshy as in the full grown crab of the same species, but still in other respects it is similar. The shield also which, in the full grown individuals, covers the head and the thorax, already exists in the more advanced embryo, and forms on each side a projection which probably covers the gills. I have not, so far as I remember, distinctly seen gills in any embryo of the animals in question—probably, because these organs are extremely minute.

Of the internal parts, I have found a heart quite similar to that of the

full grown animal in the more advanced embryo of the above-mentioned crustacea; but a liver, a ganglionic chain, and an intestinal canal, I have seen distinctly, only in the embryo of the Palæmon squilla, for it is only this embryo that can be extracted uninjured from the egg; but still, on account of their small size, I have not been able to examine the parts satisfactorily.

From this description, which, however, is merely to be considered as a rough sketch, you may be able to judge for yourself if the *Decapodes* inhabiting the sea, actually leave the egg in so extremely imperfect a condition as has been represented by Thompson. I do not wish to speak of the internal organs, for of their developement I know too little; but as to what concerns the external organs, I must confess that, in my opinion, an Eriphia or a Palæmon leaves the egg in a condition not much less imperfect—that is, in relation to its parents—than a bird. For such a crustaceous animal has, with the exception of the male parts of generation, just as many external organs; and these organs, considered separately, are composed of just as many essential portions, and occur as a whole, and, in their separate parts, in the same relative position as in the old individual. The form also of each part is of such a description, that in it we can recognise distinctly enough a certain portion of the perfect animal. Probably, however, there is no animal formed in an egg, whose individual externally observable organs, when it leaves the egg, present collectively and separately the same proportions, as they possess in their matured condition.

Slight, or only moderately great deviations in the proportions of the separate external organs, like those, (excluding the eyes,) occurring in the newly born *Decapodes*, can afford no grounds for our forming such an opinion regarding them as that expressed by Thompson. In perfect specimens of the Astacus Leptodactylus, the tentaculæ of the male in proportion to the body are at least twice as great as in the female, without our concluding that the female is much less perfect than the male. How completely different, on the other hand, are the relations of many lower crustacea in their perfect and in their imperfect condition! All the *Isopodes*, with whose developement I am acquainted, come into the world with fewer bones than they exhibit in their state of maturity—the Bopyrus squillarum has three pair less; the *Cyclopes* have no bones when they come out of the egg, and some parts of the dentary apparatus are also wanting; the Lepas and Balani resemble their parents just as little as the *Cyclopes* do when they come out of the egg. These are animals which we can say with justice and reason enter the world in an extremely imperfect condition; but, as to the *Decapodes*, so far as I have examined their developement, I must deny such an assertion, and of them I can say nothing less than at the end of their existence in the egg they have exactly the same aspect, and are as fully developed, as the full grown individuals. No physiologist would make a similar assertion regarding a newly born bird or quadruped.

We certainly remark a considerable difference between the animal when it leaves the egg and an old individual, in reference to the form of the whole body; but this arises from the circumstance of the young one carrying away a considerable quantity of yolk from the egg. The yolk fills up a large, perhaps the largest, portion of the cavities of the body. Hence the greater breadth of the thorax in the matured embryo of the Palæmon and the Crangon; hence the greater thickness of that part of

the body in the matured embryo, not merely of the Crustacea, but also of the Eriphia; hence also the circumstance, that in all of them the middle portion of the shield, in proportion to the lateral portions, is very much larger, and relatively also much thinner, than afterwards when the creature attains its full maturity. But birds also take with them from the egg a portion of the yolk, and many of them after creeping out have still a very large belly, yet nevertheless no one would assert that birds come into the world in a very imperfect condition.

The stomach and the liver may perhaps be but little developed when the crab leaves the egg, and the organs of generation may perhaps be entirely wanting; but I cannot believe that Thompson founded his assertion on these organs; for I have seen specimens of five or six species of crabs which carried eggs; but none of the eggs, so far as I remember, were larger than poppy seeds. In newly born young ones of these animals, it would, therefore, have been a difficult task to investigate the relations of the internal organs mentioned above, and which were partly covered with yolk.

In conclusion, I must remark, that I have not been able to procure a sight of the original paper by Thompson; and that I have only seen the abstract of its more important contents which was published in the Isis. Perhaps, therefore, much of what I have stated in this letter is not applicable to the memoir in question; and it may perchance turn out, that, like Don Quixote, I have been fighting against a windmill.*

EUCHYTRÆUS.

THE following is a description of Euchytræus, a new genus of Annelida, discovered by Dr. Henle of Berlin. These animals are found in situations similar to the common earthworm, generally rolled together in pellets of damp soil, amongst which they are not easily seen until they have been detached by dissolving it in water. They are found in the greatest numbers in the inside of flower-pots, on account of which the generic name Euchytræus, (from χυτρος, a vase,) has been bestowed upon them. They will live about fourteen days immersed in water. In length they vary from two to six lines. The head is pointed and conical and the tail truncated. The body is formed of a series of rings, each being barrel-shaped, or swelling out in the centre. The fifth or sixth nearest the head is proportionally longer than the rest. The number of rings varies greatly in individuals of different lengths. In twelve specimens, they ranged between nineteen and sixty-one. They are covered externally by an epidermis, beneath which is a muscular skin formed of longitudinal and transverse filaments. The organs of generation are always situate between the eleventh and twelfth rings, from which it is inferred that the growth of the animal takes place either by the addition of new rings, or by the subdivision of those already existing beyond the twelfth. Only one species belonging to this genus has hitherto been discovered, and from its colour the name

* Jameson's Journal, No. 44.

Euchytræus albidus has been chosen for it. Like the common earth-worm it moves by means of minute bristles, four groups of which are attached to each ring, viz. two on the belly and one on each side. The average number of bristles on each side is three; in the earthworm the average is two, and several other points of difference occur between them. In Euchytræus they are straight and pointed, and they sometimes seem to be attached to each other by a membrane resembling the web of a swimming bird. They take their rise in the inner muscular skin before-mentioned. In the systematic arrangement of the Annelidæ, Euchytræus occupies a place next to Lumbricus, from the similarity of its form, its organs of locomotion, and its internal structure. *Lumbricus rivalis*, described by Fabricius in the Fauna Grœnl. p. 278, seems to approach the nearest to it; but his description is somewhat vague.*

THE EUROPEAN BISON.—GEOGRAPHICAL DISTRIBUTION OF ANIMALS.

At a meeting of the Imperial Academy of Sciences at Petersburg in autumn last, M. Baer read some observations upon the above named animal, which were suggested by the reception of a skin, which had been sent to the Academy by General Rosen from the Caucasus. This animal, which is known by the name of *Aurochs* in France and Germany, and by that of *Zoubre* in Russia, and which Cuvier has shown to be the same as the *Bison* of the ancients, the *Wisent* in Germany, was, in remote periods, spread over nearly the whole of Europe. Many names of places, as *Wisantensteg* and others, are a memorial of it in Swabia. Its chase is sung in the Nibelungenlied. At the time, however, of the revival of letters it was no longer known in Germany. It maintained itself for a longer time in Prussia, and in different parts of Poland, where it was seen and drawn by Herberstain. The last that was killed in Prussia was in the year 1755. The younger Forster tells us that in his time it was found in Poland only, in the great forest of Bialowicza, from which it would have been extirpated by this time but for the care with which the Russian Government watches over its preservation. This for a considerable time has been regarded as the only locality where the Bison was to be found. It is therefore an interesting piece of intelligence to the student of zoology to be informed of its presence in the Caucasus, where are still to be met with the royal tiger and the panther. M. Baer has instituted a minute comparison between the portions lately transmitted from the Caucasus, and the specimen already in possession of the Academy, and which had been brought from the above named forest of Bialowicza, and has found that in the former

* Magazine of Zoology and Botany, No. II.

the horns are sensibly more slender and shorter, and that the distance which separates them or the breadth of the forehead is less. At the same time he conceives that these differences proceed only from the difference in sex, the Caucasian individual being a female. The colour of the hair is moreover not so deep, and is mixed with grey; it is also shorter in all the anterior portions of the body, and is curled only on the forehead, and on a part of the neck; but M. Baer still explains these differences as arising from age, the season of the year, &c. The hoofs and the ergats—those short horny stubs placed behind and below the posterns—are much shorter than in the Polish animal, which is probably connected with its mountainous habitat. There are no other differences between these two bisons, so far at least as can be judged from their skins, except a slight difference in the curve of the horns, and the presence of a dark coloured streak which runs along the back of the one, and is not present in the other. These differences, it will be perceived, are quite insufficient to enable us to conclude whether the wild bull of the Caucasus is to be regarded a distinct species from that of Lithuania, and it is only by the examination of the skeleton that this can be determined. It is now several years since notice was given of a wild bull named *The Gaour, B. Gaurus*, in the interior of India, between the coast of Coromandel and the bay of Calcutta. The existence of a zoubre or bison in the Caucasus has led M. Baer to infer that this bull is also a bison, the incomplete description which has been published corresponding with sufficient accuracy with what is known of the Caucasian animal. M. Baer also conceives it very probable that the same animal is found on the other side of the Ganges. He grounds this supposition upon the recital of Captain Low, in the Journal of the Asiatic Society of London. Finally, and moreover, he does not doubt that it now sojourns in the central parts of Asia, and extends even towards its eastern portion. In fact he agrees with Schmidt in thinking that the Mongolian writings allude to this animal, where they mention a wild bull which frequents the environs of the lake Kokkonoor, and also the Chinese province of Khânsi; which is distinguished from the *Yak, Bos Grunniens*, and which the Mongolian dictionaries thus describe. "It resembles a common ox; the anterior portion of its body is high, the posterior sloping and narrow; its coat is of a deep slate colour, or deep brown or blackish." The zoubre or bison, then, he remarks in concluding, is still at the present time dispersed into several herds and tribes, widely separated from each other. In the forest of Bialowicza it has for its companion the wolverene, Ursus Gulo Lin., and on the coast of Tenasserim the elephant and the rhinoceros. If now we recur to the notion of Pallas, who, struck with the similarity of the bison of America and the aurochs of Europe, and considering and imagining that this latter

animal was not to be found in Asia, affirmed that the European animal had travelled from the West, we shall be led to conclude that there are good grounds for questioning this opinion.

As bearing on these changes of the habitat of this urus, M. Baer makes some reflections upon the variations which the geographic distribution of animals undergo, which may be inserted here. Some animals, he remarks, travel with a particular vegetation, and others along with man; some have been presented to Europe from America, and others have passed over from the old world to the new. Amongst the Mammalia it is always the smallest, belonging to the Glires, and the Insectivora, which most prevail. The very smallest of the mammalia, the pigmy shrew-mouse, *Sorex pigmæus* of Pallas, which was never before seen in Germany, has within these few years been discovered in Silesia and in Mecklenburg. Many species of mice and rats are continually advancing from Asia into Europe. At the present time the black-rat, (Mus Rattus,) is no longer the common rat, but another stranger species, so new that Linnæus was not acquainted with it, and the epoch of whose arrival at Astrakan is ascribed by Pallas to the year 1727, has effected the disappearance of the former wherever commerce is established. This visitor is the *Surmulot* of Buffon, the *Wanderatte* of the Germans, the *Mus decumanus* of Pallas. It has been transported in our day by the Nadejda to Kamtschatka; in fact, it might be adopted as the appropriate ensign of commerce, and we might safely say that a place without the brown rat is a place destitute of commerce. On the contrary, the larger animals always retire, and finally become extinct, a proof that the issue of the contest between man, and any animal, whatever be his strength and courage, is always in favour of the lord of creation. It is thus that the lion, which, according to Herodotus and Aristotle, still existed in their times in Macedonia, after having for a long time occupied Asia-Minor and Syria, is now-a-days repelled from the frontiers of Persia and India, into some desert portions of Arabia, and is dominant solely in Africa. So, too, the crocodile no longer exists in Lower Egypt; and the hippopotamus and cameleopard, and other colossal animals, have retreated into the interior of Africa. But there are likewise species of animals which have been completely extirpated even within the period of historic records. Thus the urus of the ancients, which, in the time of Cæssr, was common in Germany, no longer existed there in the sixteenth century. And the sea-cow of the Kamtschatka seas has still a shorter history. In fact it was only towards the commencement of the eighteenth century that it was observed and known. Steller gave a detailed description in the year 1743 and in the year 1768, that is to say, in twenty-five years, after the last individual appears to have been destroyed.*

* Jameson's Journal, No. 46.

ON THE SNAKE-LIKE PROTEUS. (*Proteus anguinus* Lam.)

By a Correspondent of the Magazine of Natural History.

Cuvier, in his first edition (1817) of the *Animal Kingdom*, placed the genus Proteus among the frog-like animals "les Batraciens," which constitute the fourth order of his third class of Vertebrata, Reptiles.

I, however, consider that this arrangement is liable to many objections, not only in the application of the term reptile to this animal, but also for other reasons, which I need not here detail at length. I propose classing it in a fourth division of Vertebrata, under the old Linnæan name Amphibia, instead of referring it to that of the Reptilia *Cuv.*: thus:—

Vertebrata.—Class IV. Amphibia.
Order Manentibranchia *Mihi.* Branchiæ permanent.
Family Proteidæ *Mihi.* Genus Proteus *Laurenti.*

Before I give any account of my own observations on this remarkable animal, which may be properly termed, "branchipneumonian, (i. e., gill-lunged, breathing both by gills and lungs,) I will add the following accurate description, which the same illustrious anatomist has given at p. 102 of the *Regne Animal,* and which I have translated as follows:—

"This genus is formed, at present, by only a single species, the Proteus anguinus *Laur.*, or Siren anguina *Schn.* The animal is more than a foot in length, about equal to a finger in thickness, having its tail compressed vertically, with four little legs, of which the fore feet have three, and the hinder only two, toes. Besides internal lungs, it bears, like the larvæ or young of the salamander (Salamandra *Brong.*), three branchiæ, or gills, upon each of its sides, in the form of tufs, which it evidently retains during the whole of its life. The cartilaginous arcs, and the membranous lid, are also the same as in those larvæ. Its muzzle is elongate and flattened; both jaws furnished with teeth; its tongue is capable of being a little moved, and is loose in the fore part. The eye is excessively small, and nearly hidden by the skin, as is the case with the mole-rat; (Mus typhlus;) its ear is likewise covered by the skin, like that of the salamander. The skin is smooth, and nearly white. It is only to be found in the subterraneous waters which communicate with some of the lakes in Carniola. The skeleton of the Proteus resembles that of the salamander, with the exception of its having a good many more vertebræ, but fewer rudiments of ribs. Its bony head, indeed, is altogether different in its general conformation from that of the Salamandridæ."

Next, the characters I will briefly state somewhat thus:—

Proteida Mihi. Body much lengthened, with a tail. Legs four; fore feet having three toes, hind feet only two.

Proteus. Tail compressed vertically. Both jaws with teeth. Eyes extremely minute, scarcely visible.

descriptions; their comparative size, their colour, their habitat, their zoological characters, as far as they were reported, and, in the case of the *Koba*, even the name, were identical; and it therefore gave him peculiar satisfaction to be able to congratulate the Society on the possession of two of the rarest and most interesting *Antelopes* ever brought together. He observed, in conclusion, that the female of the *Kob* had been observed by him six or eight months ago in the Surrey Zoological Gardens, but that he had only recognised its identity with Buffon's animal on the arrival of the fine male specimen at present belonging to the Society.

VULTURES.

Nov. 8.—A letter, addressed to the Secretary, by Robert Mackay, Esq., the British Vice-Consul at Maracaibo, and a Corresponding Member of the Society, was read, describing the habits of a *Vulture* (*Vultur Papa*, Linn.) forwarded to the Society for the Menagerie, but which had unfortunately died during the voyage.

After noticing the peculiar habit attributed to these birds, (which frequently congregate to the number of three hundred,) of paying deference to an individual differing from the rest in plumage, and to which the inhabitants of Maracaibo give the title of king, Mr. Mackay proceeds to state:—

"These birds, in their flights, ascend to such a height as to be lost sight of, and, from their elevation, discover objects of prey.

"They reside in the savannas of a warm and dry temperature; and their travels do not extend beyond five or six leagues of the place where they have been bred.

"They lay their eggs, and hatch their young, in the small concavities of mountains.

"At a distance from towns, villages, and frequented roads, they generally assemble in large numbers; but in the immediate vicinity of such situations the king never deigns to associate with his vassals."

ELECTRIC RAY.

Nov. 22.—A communication from Mr. Harvey, of Teignmouth, in Devonshire, was read, which referred to a specimen of the *Electric Ray* then on the table. The fish was caught in a trawl-net, near Teignmouth, and was presented to the Society by Mr. Harvey. When taken, part of a specimen of the small spotted *Dog-fish* was hanging from its mouth. The fishermen handle the *Electric Ray* while it is alive without being at all affected by it, always taking care to lay hold of the tail.

LARGE CARP.

Mr. Yarrell exhibited a very large *Carp* taken by a net in a piece of water called the Mere, near Payne's Hill, in Surrey. The length of the specimen was 30 inches, the girth of the body at the commencement of the dorsal fin 24 inches; the weight, 22 pounds. The fish belonged to Edward Jesse, Esq., author of the "Gleanings in Natural History," by whose permission it was exhibited. Mr. Yarrell observed, that he could find no record of any *Carp* so large having before been taken in this country.

GERBOAS AND GERBILLAS.

December, 13, 1836.—M. F. Cuvier's paper on the *Gerboas* and *Gerbillas* was read.

M. Cuvier commences this memoir with observing that his attention has been particularly directed to the *Rodentia*, with a view of arriving at a natural classification of the numerous species composing that order, among which considerable confusion had hitherto prevailed, particularly in the genera *Dipus* and *Gerbillus*, the relations of which to other allied groups have been but very imperfectly understood by previous writers.

The species included in the genus *Dipus* have been formed by M. Lichtenstein into three divisions, which are distinguished by the absence and number of rudimentary toes upon the hind feet. In the first section are placed those with three toes, all perfectly formed; in the second, those with four, one of which is rudimentary; and in the third, those with five, two of these being rudimentary. M. Cuvier states that he is unacquainted with the second division of M. Lichtenstein, but in the examination of the species belonging to the first, in addition to the absence of rudimentary toes, he finds they are also distinguished from those of the third by the form of the teeth, and the osteological characters of the head. These points of difference he considers of sufficient importance to justify his making a distinct genus for the *Gerboas* with five toes, adopting the name *Allactaga*, given by Pallas to a species, as the common generic appellation.

"We know," observes M. Cuvier, "that the three principal toes of the *Allactagas*, as well as the three only toes of the *Gerboas*, are articulated to a single metatarsal bone, and that the two rudimentary toes of the first genus have each their metatarsal bone; whence it results that the penultimate segment of the foot is composed of three bones in the *Allactagas*, and of one only in the *Gerboas*. The incisors of the *Allactagus* are simple, whilst those in the upper-jaw of the *Gerboas* are divided longitudinally by a furrow. The molars of the latter genus are complicated in form, and but little resemble those of the former. They are four in number in the upper-jaw, and three in the lower, but the first in the upper is a small rudimentary tooth, which probably disappears in aged individuals."

The structure of the grinding teeth is then described in detail, and illustrated by drawings which accompanied the paper.

"The general structure of the head of the *Allactagas* and *Gerboas* is evidently the same, and is characterized by the large size of the *cranium*, the shortness of the muzzle, and above all by the magnitude of the suborbital *foramina*. The cranium of the *Gerboa* is distinguished by its great breadth posteriorly, resulting from the enormous developement of the tympanic bone, which extends beyond the occipital posteriorly and laterally as far as the zygomatic arch, which is by no means the case in the *Allactagas*, where all the osseous parts of the ear are of moderate dimensions. Another differential character between the two genera, is presented by the maxillary arch, which circumscribes externally the suborbital foramina, and which, in the *Allactagas*, may be said to be linear, and presenting a very limited surface for the attachment of muscles. Lastly, we may note a difference in the relative developement of the jaws, the lower being comparatively much shorter in the *Allactagas* than in the *Gerboas*."

The author then proceeds to describe a new species of *Allactaga*, a native of Barbary, for which he proposes the name of *A. arundinis*. Its length from the origin of the tail to the end of the muzzle, 5 inches; length of the tail, 5 inches and 2 or 3 lines; of the ears, 1 inch; length of the tarsi from the heel to the extremity of the toes, 22 lines. All the

upper parts of the body are of a beautiful greyish yellow, with yellowish sides and tail of the same colour, terminated by a tuft of a blackish brown at its origin, and white at the extremity. The sides of the cheek, the ventral surface of the body, and the internal limbs are white; large brown moustaches adorn the sides of the muzzle. The incisors are white and entire, the ears almost naked.

M. Cuvier next proceeds to consider the characters and affinities of the genera *Gerbillus* and *Meriones*, and enters into a critical examination of all the species referred to that group. To these he adds another species, the habits of which he details, and describes at length under the name of *G. Burtoni*. The species which he thus includes are, 1st, *G. Egyptiacus*, syn. *Dipus Gerbillus*, *Meriones quadrimaculatus*, Ehrenberg; 2nd, *Gerbillus pyramidum*, syn. *Dipus pyramidum* Geoff. *Meriones robustus* Rupp; 3rd, *G. pygargus*, syn. *Meriones Gerbillus*, Rupp; 4th, *G. Nidicus*, syn. *Dipus Nidicus*, Hardwicke; 5th, *G. Africanus*, syn. *Meriones Schlegelii* Smutz., *G. Afra* Gray; 6th, *G brevi-caudatus*; 7th, *G. Otaria*; 8th, *G. Burtoni*. The author enters into detailed descriptions of each of these species from original specimens. M. Cuvier lastly considers the affinities of the *Gerbillas* and *Allactagas* to the *Gerboas*, and concludes that the *Gerbillas* have a much nearer affinity to the *Muridæ*.

PHOSPHORESCENCE OF THE OCEAN.

January 10, 1837.—A paper was read, entitled "Observations on the Phosphorescence of the Ocean, made during a voyage from England to Sydney, N.S. Wales." By George Bennett, Esq., F.L.S., Corresp. Member of the Society.

The author commences this paper with adverting to the very slight progress which naturalists have made in their attempts to elucidate the history of the phenomena connected with the phosphorescence of the ocean, and notices some of the imaginary advantages which former observers have attributed to its presence; among others that of its indicating to mariners the existence of shoals and soundings, a circumstance which his own experience has not enabled him to confirm. He then proceeds to remark, that the sea, when phosphorescent, exhibits two distinct kinds of luminosity, one in which its surface appears studded with scintillations of the most vivid description, more particularly apparent as the waves are broken by the violence of the wind or by the passage of the ship through them, as though they were electric sparks produced by the collision, and which scintillations he considers are probably influenced, in some measure, by an electric condition of the atmosphere, as at those particular times they were observed to be much more vivid and incessant than at others. The other kind of luminosity spoken of has more the appearance of sheets or trains of whitish or greenish light, often sufficiently brilliant to illuminate the vessel as it passes through, being produced by various species of *Salpa*, *Beroe*, and other Molluscs, while in the former case the scintillations, which adhere in myriads to the towing net when drawn out of the water, probably originate in animalcules so minute that the only indication of their presence is the light which they emit.

The author remarks that "the luminosity of the ocean is often seen with greater constancy and brilliancy of effect between the latitudes 3° and 4° north and 3° or 4° south of the equator, than at any other part of the tropical regions. This circumstance, which I have observed myself,

if found to be borne out by repeated observations, may be occasioned by the eddies arising from currents, for it is a curious fact worth noticing, that where currents are known to exist, the luminosity of the ocean has been observed to assume a higher degree of brilliancy. Now the westerly current is supposed to run between those parallels of latitude from 20° or 22° west longitudes towards the Brazilian coast perpetually, and it is not improbable that nearly at the termination of the north-east trade wind a current joins with a similar current carried by the south-east trade wind; both uniting in forming the westerly current may thus cause a greater assemblage of the various tropical molluscs and crustaceous animals, a number of which possessing luminous properties may impart by their presence a higher degree of phosphorescence in that particular portion of the ocean than is observed in other situations except from similar causes. That the diffusion of the phosphoric light possessed by these molluscs does not solely depend on the creatures being disturbed, (such as the passage of the ship through the water, or other somewhat similar causes,) is evident, as a luminous mass may frequently be observed to gradually diffuse its brilliant light, at some distance from the ship, without any apparent disturbance; and often during calm nights a similar glow of light is diffused over the water, without there being any collision of the waves to bring it forth; and if a light breeze springs up during the same night, the passage of the vessel leaves no brilliant trace in its wake, although the same spontaneous diffusion of light is observed in the water at some distance to be repeated as before; the phosphoric light being confined apparently solely to the occasional groups of molluscs, which when we succeeded in capturing them in the towing net, resembled for the most part pieces of crystal cut into various fantastic forms, round, oval, hexagonal, heptagonal, &c. From the bodies of these a faint or a bright light, (according to the greater or less duration of time the animal may have been removed from the water, that is, we may say, by the intensity of its light we can judge of its healthy or vigorous state,) would be seen to issue in minute dots from various parts; and on the examination of both large and small specimens, the large with the naked eye and the small under a powerful lens, I could not detect any one peculiar secreting organ for this luminous excretion.

"It has often occurred during the voyage that the ocean became suddenly brilliantly luminous, and at other times merely a constant succession of scintillations were visible. Again, it was remarked that no luminosity of the ocean was visible except what proceeded from the wake of the ship, and other parts of the ocean exhibiting no phosphorescence.

"On the 15th of April, 1835, in lat. 8° 45′ north, and longitude 21° 02′ west, during the day large quantities of a beautiful pink *Medusa* were taken in the towing net, which species I was previously aware possessed luminous powers, and as expected, at night the ocean was brilliantly luminous, which luminosity continued till about 8 P.M., after which time it had almost totally disappeared. During the time the phosphorescence was visible, the *Medusa* before mentioned was captured in large numbers, but on the disappearance of the luminosity no more were caught, evidently showing that the phosphorescence of the sea this evening was occasioned by their presence. I have frequently remarked that when the ocean appears brilliantly luminous, besides the animals producing the phosphorescence, several crustaceous animals and a number of small fish are usually taken in large quantities: the presence of these may proceed from their being attracted by the phosphoric light. Some-

times during heavy rains within the tropics the sea would become suddenly luminous, as rapidly passing off again, and the effect of the sudden transitions was exceedingly splendid to the beholders. During its continuance luminous species of *Salpa, Beroe, Pyrosoma,* and other molluscs were captured in the towing net if the weather admitted of its being placed overboard."

On placing some of these luminous *Medusæ* in a bucket of water, Mr. Bennett observed that the phosphoric light is not emitted from any one particular part of the animal, but commences at different points, gradually extending over the whole body, sometimes suddenly disappearing, and at others slowly dying away. Upon squeezing the animal the hands became covered with a profusion of the luminous secretion, which could be communicated from one object to another. In conclusion several additional instances are related, occurring in different latitudes, of the beautiful and varied appearances presented by the phenomena of marine phosphorescence.

YOUNG FEMALE ORANG-OUTAN.

The collection of the Zoological Society has been enriched by the acquisition of a young living Orang Outan: it is a female, and its age is supposed to be between three and four years, the state of the dentition being taken as a criterion, combined with its stature and the condition of the bones of the skull. Its height from the top of the head to the heel is two feet two inches. Of the rapidity or slowness of the growth of the Orang, and of the natural duration of its life little or nothing is known.

As there is some doubt with respect to the exact locality whence the young Orang at the Gardens of the Zoological Society was originally brought, a degree of difficulty exists as to which of the species it is referable,—for the *Simia Morio*, (see page 231,) is known only from its skull, upon the difference between which, and the skull both of the great Bornean and the Sumatran Orangs, the species is founded. If Borneo be the native locality of the animal in question, it may possibly be the young of the great Bornean Orang, the female of which is destitute of callosities on the cheeks, these being peculiar to the male and only acquired by him at an adult period. Of the external characters of the *Simia Morio* we have no information, it is therefore hazardous to say positively that the young Orang is not of this species; but were we to hazard a conjecture, we should incline to the idea of its being the young of the Sumatran; like all the females of that species yet examined, it wants the nail on the thumb of the hinder-hands; and in the rufous colour, the texture and general character of the hair, the similarity is also carried on. We may here observe, however, that many of the best continental naturalists do not consider that three distinct species are really established.

At a first glance, the young Orang in question reminds us of the Chimpanzee the death of which occurred in April, 1836, but a more attentive inspection leads us to perceive many differences, both as regards external characters, and even habits. In the Chimpanzee the arms, though long, were far shorter than in this animal, and the thumb of the hinder-feet was far more developed, and furnished with a nail. The hands both of the fore and hind limbs are much longer and narrower in the Orang than in the Chimpanzee. In the latter the back of the fore-hands was naked to the wrist,—in the Orang the back of the hands is covered with hair;

in both the hair of the fore-arms is reverted to the elbow. The hinder-limbs were better developed in the Chimpanzee than they are in the Orang, and their action was more firm and steady,—in the Orang the absence of the *ligamentum teres*, or binding ligament of the hip-joint, while allowing the utmost freedom of motion to the limbs, tends to render them less fitted to serve as organs of support or progression on the ground. In the Chimpanzee the ears were large and spreading out from the head; in the Orang they are small and close. In the former the hair of the head radiated from a centre, and the forehead was low and flat; in the latter, the hair of the head is all directed forwards, there being no centre of radiation; the forehead is large and convex, with a slight perpendicular elevated line indicating the suture of the two frontal bones. In both animals the lips are capable of extraordinary protrusion, but the chin was larger in the Chimpanzee and more prominent—the cheeks still more wrinkled, and the muzzle furnished with thinly scattered white hairs, giving a grotesque picture of age in contrast with the playful habits of a child. In the Orang, the chin retreats at once from the protruding lips, and no white hairs are scattered around the muzzle. In the voice of the two animals as wide a difference as possible exists. The Chimpanzee was capable of uttering deep guttural sounds of considerable power, as well as louder cries; but the voice of the Orang when displeased or disappointed, is a feeble plaintive whine or low scream, and it is only at such times that it is exerted.

If the ground be not the true place for the Chimpanzee, still less is it adapted as a station for the Orang to occupy. All who have had opportunities of observing the Orang on the ground record its slow and vacillating mode of progression; a motion dependent rather on the arms, which from their length act as crutches supporting the body between them, than upon the hinder limbs, which are ill calculated for such service. When left entirely to itself on the floor, the little inmate of the Zoological Gardens, if incited to walk, supports its weight on its arms, applying the bent knuckles to the ground; and so long are the arms, that it stoops far less in this attitude than did the Chimpanzee,—indeed it is very nearly erect; the hinder limbs are at the same time bowed outwards, and the outer side rather than the sole of the foot is placed upon the floor. Thus supported, it waddles along, the movements of its hinder limbs reminding us of those of a rickety child just able to walk alone: it is plain that the arms have the most to do in this exercise; often indeed, and that the more especially when it wishes to move quickly (as when following its keeper), it fairly swings the body forwards between the arms, as if impatient of the hobbling gait to which the structure of its lower limbs restricts it. That its lower limbs however, with slight assistance, are not incapable of supporting the body, and that it can waddle along very fairly, using these alone, we have repeatedly witnessed. For instance, it will walk, and at a tolerable pace, comparatively speaking, by the side of a person holding it by the hand, and in the narrow space between the outside railing and the front bars of the giraffes' house (the apartment in which it is kept), it walks with great facility, availing itself of the railing on one side, and the edge of the elevated floor on the other, along which to run its hands by way of steadying itself. In the giraffes' house (before alluded to) it has an inclosure or large cage of its own, railed off from the rest of the apartment by a fencework of bamboos. Here are two artificial trees with numerous branches, among which it may climb at pleasure. Remembering the activity and the merry antics

of the Chimpanzee, we expected to see far more liveliness and celerity in the climbing movements of this little Orang than were displayed. We were struck with one thing in the hands, and more especially in the feet, of this Orang, while climbing, which we do not think has been noticed so clearly as it merits, namely, that they are rather hooks than true graspers. In the Chimpanzee, the thumb of the hinder hands is large, and it grasps very firmly with these organs, for we have seen, that, resting on the back of a chair or on a perch, it can throw itself backwards and raise itself again into its previous position, grasping by them alone; but in the Orang the extraordinary length of the foot and the rudimentary condition of the thumb, which serves but as a very inefficient antagonist to the long fingers, would seem to militate against the possibility of that close energetic grasp being exerted which such a feat as we have alluded to would require. At all events, the young Orang in question, as observed by us, used its hinder feet more as hooks than as decided graspers; and it may be added that their hook-like rather than grasping character affords a reason, amongst others, why the animal cannot possess the peculiar activity of the monkey or the lemur among the branches. The observations of M. Fred. Cuvier respecting the progressive movements of the Orang, as noticed by himself, agree very closely with those which an attention to the habits of the present living animal have suggested. (See Annales du Muséum, tom xvi.)

Though this animal is naturally and habitually dull and inanimate, it has times of sportiveness, when it readily engages in play with those to whom it is attached, follows them to court their notice, or pursues them in mimic combat. Confinement, which is irksome to all animals, is evidently distressing to this little Orang: it cannot bear to be separated by intervening bars from its keeper. It is very questionable whether, if perseveringly confined for several hours together every day, it will not pine, to the injury of its health, so much does it dislike to be left alone.

Dressed in its Guernsey jacket and trousers, a sort of clothing which it needs in our climate, its appearance, seated on its chair, or at the table with its keeper in his private room, is very amusing; nor less so the expression of its countenance, when soliciting a share of the food before it: it looks at its keeper, looks at the tempting morsel, and protrudes its flexible lips into the form of a conical proboscis; when offered any liquid to drink in a cup or saucer, it does not, however, dip its lips into the fluid, but holding the cup in its hand, puts the rim between its lips, and so drains up the contents, exactly as a child would do under similar circumstances, and with all due gravity and decorum. Disappointment is trying to all, and this little Orang is not an exception to the general rule: it does not endure it with unruffled feelings. Mr. G. Bennett (see his "Wanderings," &c., vol. i. p. 367), speaking of on Orang which he had the opportunity of seeing in the possession of Mr. Davies at Java, observes, that when a large bamboo cage was constructed, and in which it was attempted to confine him, "he screamed with rage on being placed in it, and exerting his muscular power, soon demolished it, and was then quiet as before." The same gentleman also notices the rage produced by disappointment in a species of Gibbon, which he was endeavouring to bring home, and which, as he says, "when refused or disappointed at anything, would display the freaks of temper of a spoiled child, lie on the deck, and dash every thing aside that might be within his reach; walk hurriedly, and repeat the same scene over and over again." It is much in the same manner that this little Orang displays its passion,

throwing itself about on the floor, and uttering its whining cry till satisfied, and satisfied it must be before it will resume its ordinary composure. The person who brought it to England intimated that it had exhibited several violent paroxyms of passion while on board; and occasionally since its introduction into the Zoological Gardens it has indulged in fits of anger: but as kind treatment is the uniform course pursued towards it, occasions of such an outburst but rarely occur; unless indeed when it is confined in its inclosure, and necessarily separated from the person in charge of it."

The young Orang of the Zoological Gardens, we need not say, is not the first of its race which within the last few years has been brought to our shores; but it is certainly the first which so fairly promises to reward, by a long residence in its new domicile, the care manifested towards it, and the exertions to maintain it in health and comfort.*

BOTANY.

OPERATION OF THE EARTHS IN THE PROCESS OF VEGETATION.

THE following is an abstract of a paper on this subject, lately communicated to the French Academy of Sciences, by M. Pelletier. Resting his opinion on the observations of agriculturalists and chemists, and more particularly on the analyses of various soils made by Chaptal, Davy, and himself, the author admits that a fertile soil must be formed of siluca, alumina, and lime; that the fertility diminishes as one of these three earths predominates; and that it is almost null when the mixture presents only the properties of one of them. But why, and how is this mixture of three earths, with the addition of oxide of iron or magnesia, a necessary condition of fertility? "This question," says M. Pelletier, "has not yet been satisfactorily answered. The physical constitution of the soils, their hygroscopic properties, their power of being more or less strongly heated by the solar rays, are circumstances to which a certain influence may reasonably be attributed, but which, nevertheless, appear to be only secondary causes. *It seems, on the contrary, evident, that* the mixture of the different earths which compose the soil, acts on vegetation by an electro-chemical force, whose influence has been recognised in other circumstances, but which has not hitherto been pointed out as connected with the subject now under consideration."

M. Pelletier remarks, that in a fertile vegetable soil the si-

* Abridged from the Penny Magazine, No. 375. (February 3, 1838.)

lica, lime, and alumina, must exist in a state of simple mixture; that if these substances were combined the soil would be sterile; and that, in a mixture of these three earths, the fertility would cease, if the combination were to be effected instantaneously. "For," says he, "in a mixture of silica, alumina, and lime, there exists a force which must tend to combine these substances; the silica and alumina are electro-negative bodies in respect to the lime, and in their presence the lime must acquire the opposite electrical condition. Thus, according as exterior movements, which are foreign causes, place the molecules at a greater or less distance, and group them in different manners, electrical piles are established, the degrees of tension will vary, discharges will take place, and the soil will be as it were animated. The electric fluid which pervades it, will excite the radicular stomata, and the absorption of the fluids proper to the nourishment of the vegetable will take place; and the radicular fibres impregnated by humidity, will become charged conductors for transmitting electricity to the plant, an electricity which is certainly as necessary to life as light and heat.

M. Pelletier afterwards considers certain practical operations in agriculture for improving soils, such as the mixture of beds of earth of different kinds, the use of marl, the exposure of marls to the air, tillage, and the use of lime; and he endeavours to deduce from his theory an explanation of the useful effects produced by these operations. He then examines why, at great depths, where he thinks that the oxygen of the air and the carbonic acid cannot penetrate, the radicles of the old trees can find carbonic acid, which, when absorbed, furnishes the carbon necessary for the nourishment of the vegetable. He admits, seeing the tendency that silica and alumina have for combining with lime, that there is a reaction of these two earths on the calcareous carbonate, a combination, a formation of a silicate, and a disengagement of carbonic acid. Thus, then, according to M. Pelletier, at certain depths, and under influences hitherto but little known, the silica would decompose the carbonate of lime, while at the surface of the earth, and under the influence of external agents, the silicates would be decomposed by carbonic acid.*

ON THE ALGÆ WHICH COMMUNICATE A RED COLOUR TO THE WATERS OF SOME SALT MARSHES.

By M. F. Dunal.

We often perceive in the reservoirs of salt-works, termed tables, water of a beautiful rose colour with a violet reflection, or water having a ferruginous orange-red tint, at the edges of which we observe a scum of the same colour. Water thus coloured is very

* Jameson's Journal, No. 47.

dense (25 to 26 degrees of Baumé), and is just at the point of depositing crystallized marine salt; but this phenomenon is by no means so common as it is believed to be, and, to use the expression of the salt-makers, it only occurs in old water. Very often the tables crytallize without our perceiving in the water any trace of red matter. Thousands of quintals of salt have been collected this year in the salt-works of Bagnas de Villeneuve, and at that of Peccais, and scarcely any coloured salt has been met with. The red colour of salt-marshes had been attributed to the presence of a small *branchiopode* the *Artemia salina;* but M. Dunal has visited several salt-works where that crustaceous animal existed in innumerable quantities, and where the water, nevertheless, remained limpid and colourless. The *Artemia salina* observed in these waters was not at all red; the young individuals had a greyish colour, and those more advanced in age a rose tint, approaching the colour of rust. When the water is concentrated by evaporation, the crustaceous animal acquires a red colour, but the water itself is not at all tinged. We cannot attribute the red colour of the water of salt-works to the dead remains of the Artemia salina; for, at the salt-works of Bagnas and of Peccais, MM. Dunal and Legrand observed a considerable quantity of the dead animals half decomposed, which had a milky appearance.

Not being able to assign the presence of the *Artemia salina* as the cause of the colouration of the water, M. Dunal began to investigate the phenomena with attention. On taking some water from the upper part of a pool, which seemed filled with a liquid of a beautiful rose colour, or rose tinged with a violet reflection, M. Dunal only obtained a colourless liquid; but when he plunged his vessel to the bottom, he brought up some coloured matter. This substance, when submitted to the microscope, presented to M. Dunal numerous spherical globules, which were extremely small and hyaline, and seemed to be a true *Protococcus*, to which he has given the name of *Salinus*. This small plant is developed at the bottom of the water, and its beautiful rose or violet colour is reflected through the whole of the liquid which covers it. In other reservoirs where he did not find the *Protococcus salinus*, M. Dunal discovered another substance of a deep orange-red colour, which appeared at the surface of the water. On being submitted to a magnifying power of 200 times the diameter, this substance exhibited a union of numerous individuals of a species of the genus *Hæmatococcus*, one of the simplest of the family of the Algæ, and which is characterized by its red *seminules* or globules. It is worthy of remark that it is another species of the same genus, the *Hæmatococcus Noltii*, which gives the colour to the peat-bogs of Schleswig. The *cellules* of the Hæmatococcus observed by M. Dunal, and which he names *Salinus*, are spherical or elliptical, at first of an orange-red, and afterwards of a ferruginous colour. In the laminæ of crystallized

salt, M. Dunal observed long, reddish threads. These were produced by the Hæmatococcus salinus imprisoned in the crystals of salt; and these crystals being dissolved, the plant is reproduced in a state of perfect preservation. In the middle of the salt-work of Bagnas, M. Dunal has sometimes seen floating a red substance, which assumes the elongated form of a mass of Confervæ. The Hæmatococcus salinus was at that place mixed with another rudimentary alga, which is merely a simple hyaline tube, without ramification or articulation, terminated by a point, and perfectly empty. This is a species of *Protomena*, to which M. Dunal gives the name of *Salina*. Although this botanist mentions a *Protococcus salinus* and a *Hæmatococcus salinus*, yet he thinks that these two pretended species, which, according to the divisions generally adopted, it is necessary to range under two different genera, are one and the same plant, which, when young, is a Protococcus and when more developed is a Hæmatococcus.

The salt assumes the tint of the different vegetables it incloses; it is orange-red, or of the colour of rust, when it contains the Hæmatococcus, and of a beautiful rose-violet tinge, when it includes the Protococcus. A delightful violet odour is exhaled by these coloured salts, and is retained for a year, when they are heaped up in prismatic masses termed *Camelles*. The colouring matter formed by the Hæmatococcus, full of globules of an orange-red tint, stains the hands strongly. M. Dunal gives no details regarding the *Artemia salina*, as M. Andouin has already announced that he is investigating that *branchiopode*.*

FLOATING MASSES OF FUCUS OCCURRING NEAR THE CAPE VERD ISLANDS.

M. Kunth lately presented to the Academy of Sciences of Paris, in the name of M. Meyen of Berlin, a specimen of the *Sargassum natans* (Fucus natans, Linn.) brought from the celebrated *Mar de Sargasso*, near the Cape Verd Island. M. Kunth remarked, that this individual, like all the others observed by M. Meyen in these latitudes, does not present the slightest trace of a point of attachment. It was therefore never attached to rocks or to any other supporting body at any period of its growth, but must have been developed floating on the surface of the sea. The opinion generally adopted by voyagers, that these plants have been torn from their original situations by the waves, and collected by currents in the Mar de Sargasso, appears to M. Meyen to be inadmissible; and he is inclined to believe that they have been produced at the place where they are observed. The same naturalist maintains that such individuals formed at the surface of the water never exhibit fructification.†

* Jameson's Journal, No. 47. † Ibid.

ROOT FOR INTOXICATING FISH.

On May 11, at the Botanical Society of Edinburgh, Dr. Douglas Maclagan exhibited specimens of a root called *Hiarry*, received by him from Mr. Watt, surgeon, Demerara, which is used by the natives of British Guiana for intoxicating fish. The botanical information regarding the plant was chiefly obtained from a slight sketch sent along with the roots; for no light had been thrown on the subject by consulting botanical works. The flowers are papilionaceous, light purple, five or six on a lax raceme, the pod about the size of the common Laburnum, smooth, containing eight or nine seeds. The root, though dried, was found to retain the property of poisoning fishes; and a watery extract was ascertained by various experiments to produce on fishes nearly the same effect as Turkey Opium, and to be superior in activity to the extracts of Belladonna, Hyoscyamus, and Conium. A chemical examination of the root showed, that besides a large quantity of gum and colouring matter, it contained a resin of a light yellow colour and peculiar smell, and an acid differing in quality from any known acid,—but regarding the state of combination of which in the plant, no precise information had been obtained. One-fourth of a grain of this acid, obviously not in a state of purity, poisoned a minnow in half an hour. The effects of the *Hiarry* upon minnows, and comparative experiments with opium, were shown in presence of the society, in which Dr. Balfour, who read the paper in the absence of Dr. Maclagan, was kindly assisted by Professor Christison.*

GLASS CORRODED BY A LICHEN.

A correspondent writes to the *Medical Gazette:* Several pieces of glass were lately brought to me by a glazier in this city, taken from the old windows of an ancient church in the vicinity; some of these had the appearance of being worm-eaten. Struck with the singularity of this, I immediately commenced an investigation of the circumstance, that I might ascertain by what agency this corrosion had been induced. Upon making a minute examination, I found it was caused by the instrumentality of a cryptogamic plant, I believe of the lichen species. The first indication of the plant was a greenish pulverulent mould on the surface of the glass; in this substance some light-coloured brown dots appear; these enlarge, and form cup-like substances of a slightly violet tinge; these plants increase, and become fully developed. The glass is gradually acted upon, being first a little roughened and indented; afterwards small cavities, some even penetrating a considerable distance into the substance of the glass, are formed. Not having read or heard of any plant having hitherto been discovered capable of decom-

* Magazine of Zoology and Botany, No. 10.

posing and growing on and in the substance of glass, I thought it right to make a public communication of the fact through the medium of the pages of your valuable periodical, leaving it to other and abler naturalists and philosophers to disclose the kind of agency, whether chemical or galvanical, by which this singular decomposition of glass is effected. Glaziers inform me, that glass similarly acted upon may be met with in cathedral and old church windows.*

CULTIVATION OF PLANTS.

THE following interesting facts have been reported to the British Association, in a paper communicated by Prof. Lindley from Mr. Ward, on the cultivation of plants without ventilation. These experiments originated from Mr. Ward's unsuccessful attempts to rear plants in a confined and smoky situation in London. They were made in small bottles and glass cases of various sizes, and houses of twenty-five feet in length. They went to prove the possibility of growing plants under these circumstances, and would be one of the greatest discoveries made in the manner of transporting living plants from distant countries under a varied temperature. Many cases had been already received in this county, and the Messrs. Loddiges bore testimony to the success which had already attended the plan. On one occasion, plants were shipped at New Holland at a temperature of 80°; in passing Cape Horn the temperature fell to 20°; at Rio it rose to 100°; afterwards to 120°; and on arriving in England it again fell to 40°; but when taken out they were in perfect condition, notwithstanding the various changes of temperature they had undergone. This method of growing some plants of no great size in our rooms, and of noticing their various modes of growth, might be applied to many purposes of experiment. Mr. Yates read the report from the Committee in Liverpool for growing plants on Mr. Ward's plan. The green-house which had been erected on the above construction, was stocked with eighty species of plants, and, so far as time had yet been afforded, they appeared to be thriving and fulfilling every expectation. The report gave rise to some interesting discussion on the power possessed by plants to exist in vessels excluding the external air, and also on the practicability of introducing small animals, or at least those of the lower classes, along with the plants. Dr. Graham considered, that with plants no necessity for circulation of air existed, but the vessel must be placed in such a situation as to receive the influence of the sun, for the purpose of causing the leaves to reproduce the atmospheric air. He had found that several of the Cacti throve better in the moist atmosphere of a closed glass, than in the dry state in which they are generally kept, and that he had grown species in his own room in this

* Quoted in the Magazine of Zoology and Botany, No. 10.

manner for the last two years, some of which had not received water for eighteen months. The plants which the doctor found to thrive best under this treatment were the Lycopodii, the Grasses, which throve remarkably, Begoniæ and Cacti. Orchideous plants did not thrive under these circumstances; and seed had never been seen to be produced or ripened by any of the plants Animals he considered could not exist, for the reason that they had no power to reproduce the atmospheric air; and the quantity which they would consume would be so disproportionate to that produced by the plants, as to be either insufficient for their maintenance, or would require vessels much too large for the purpose of convenient experiment. Professor Lindley bore testimony to the importance of this discovery, and to the perfect manner in which some plants had been transported. The *Arucaria* had been brought home and transplanted with the greatest success. He concurred generally with the opinions expressed by Dr. Graham.*

STRUCTURE OF PALMS.

At the late meeting of the British Association, Mr. Bowman read a paper from Mr. Gardner, "On the internal structure of the wood of Palms." The attention of Mr. Gardner, who is residing in Brazil, was directed to this subject by the remarks made by Professor Lindley, in his "Introduction to Botany." In order to test the truth of the theory of Mohl, he made several experiments on the palms in his district. He made a vertical section of a palm, four inches in circumference, and, by doing this, he could trace very plainly woody fibres proceeding from the base of the leaves to the centre of the stem, at an angle of 18 degrees; they then turned downwards and outwards to within a few lines of the external cortical part of the stem, running parallel with its axis. The distance between these two points was about two feet and a half. The fibres were traced quite distinctly up into the centre of the leaf. In answer to the questions proposed by Lindley in his work, the author stated: 1. That the wood of palms was always hard and compact outside, gradually getting softer towards the centre, the fibres of the upper leaves not descending to so great a depth as the lower. 2. The wood is much harder at the bottom than any other part of the stem, the inhabitants of tropical climates using only this part for economical purposes.

Professor Lindley observed, that this paper confirmed the views of the structure both of endogens and exogens, which had been increasingly embraced by botanists. In the first place, the views of Mohl on the structure of endogens were confirmed. There was, however, a slight difference between Mr. Gardner and Professor Mohl; the latter having stated that the woody fibres of endogens terminated in their cotical integument, whilst

* Magazine of Zoology and Botany, No. 10.

the former had traced them only within a few lines of this point. In the next place, the paper confirmed the theory of the formation of wood from the emanation of fibres from the leaves. Whatever might be the difference between the arrangement of the fibres of oxogens and endogens, there could be no doubt that their origin was the same. Mr. Gardner had referred, in his paper, to the glandular disks on the woody fibre that were, at one time, thought to characterize the order Coniferæ. He would, however, draw the attention of the section to a fact that had lately been discovered, and not hitherto published, that these glandular disks existed on all the woody fibres of plants that yielded resinous matter. Brown first discovered them in the wood of Tasmania (Winteraceæ), and Griffiths had since demonstrated them in Spherostema (Schizandreæ).*

CONSERVATION OF LIVING PLANTS DURING LONG VOYAGES.

Extract from a letter from M. d'Eaubonne:

"Having constructed a case so that the air could not enter, by carefully fixing several bands of linen on all the joints with a glue not liable to alteration, I prepared," says M. d'Eaubonne, "with potters' clay, cow dung, and water a somewhat liquid mortar, in which I immersed the roots, having previously coated the stem; this being done, I covered them with moss and placed them in the case, filling the intervals carefully with straw, so that no friction might take place from the pitching or rolling of the vessel. I closed the case; and, after having used the same precautions for the exterior joints as for the inner ones, I had it placed in the hold of the vessel which was to carry it to the isle of Mauritius. The vessel arrived safe, the case was disembarked and opened before the customs, and instead of dry and sapless wood as was expected to be found, trees covered with leaves and flowers, much to our surprise, were to be seen. These trees were afterwards distributed among several inhabitants of the colony."—*Comptes Rendus, August*, 1837, *p.* 260.†

THE PITCHER-PLANT.

M. C. de L'Escalopier, a distinguished horticultural amateur, has communicated to the Council of the French Horticultural Society the following curious fact. The gardener of the hot-house at Montmartre found one of the pitchers of the Pitcher-plant, *Nepenthes distillatoria,* entrusted to his care, filled about half full of limpid, sweetish water. This phenomenon, which is so well known as a property of this plant in its native equinoctial regions, has never been before observed in these northern climes.‡

* Philosophical Magazine, No. 70.
† Quoted in the Philosophical Magazine, No. 70.
‡ Magazine of Popular Science, No. 22.

MODE OF PRESERVING LARGE PLANTS OR SHRUBS, IN A LIVING STATE, DURING LONG VOYAGES.

Having prepared an air-tight case, by carefully covering all the joints, &c. with several strips of cloth, thoroughly glued down to the wood, mix up a liquid mortar, composed of potters' clay, cow-dung, and water, which spread over the stems of the specimens, and into which dip their roots. Next surround them with damp moss, and pack them tightly in the box with straw, to prevent their being shaken about by the motion of the vessel. Then close the chest, using the same precautions to render the covering air tight employed for the other joints of the wood. A case made as above was forwarded to the Mauritius, where on its arrival it was opened, and the shrubs, &c., found in full leaf, and in flower.—*Extract from a Letter of M. D'Eaubonne.**

NEW ALLOCATION OF THE BOTANICAL ORDER OROBANCHACEÆ.

Dr. Lindley communicated a paper to the British Association at Liverpool on this order, in which he states very sufficing reasons for changing its place in the natural system; he pointed out new affinities for it due to peculiarities of structure, of higher importance than those which have hitherto caused it to be ranked next to the order Scrophularaceæ. This station was assigned to Orobanche in consequence of its monopetalous, didynamous flowers, and bicarpellary polyspermous fruit. Dr. Lindley has lately been calling the attention of botanists to the injurious tendency of considering monopetalous structure as of more than *generic* importance; and having clearly proved this by numerous examples of intimate affinities being violated by adherence to the common views on this subject, he called attention to the fact, that the carpella in the Orobanche, instead of being *posterior and anterior*, with regard to the axis, as they are in Scrophularaceæ, are lateral, as is the case in Gentianaceæ. From the constancy of this character in those orders in which it is found, it ought justly to be considered of primary importance; and when to this is added the fact, that the seeds of Orobanche are *albuminous*, i. e. the albumen constitutes the greater part of the bulk of the seed, as is the case with those of Gentianaceæ, while the seeds of all the Scrophularaceæ are *exalbuminous*, there can be no doubt that Orobanchaceæ should be separated from the latter order, to be placed next to the former, of which it may be considered a didynamous form.

Considering the agreement in the albuminous character of their seeds, and in their leafless, scaly, brown, parasitical habits, between Monotropæ and Orobanche; and further that the order Pyrola, in which the genus Monotropa has hitherto been placed, approaches Gentianaceæ in more important characters than those

* Quoted in the Magazine of Popular Science, No. 20.

by which it is allied to Ericaceæ, Dr. Lindley further proposes placing Pyrolaceæ, (including Monotropæ,) Orobanchaceæ and Gentianaceæ next each other.

The Professor's paper contained some curious observations on the placentation of Orobanchaceæ, from which he infers that the admitted rule that the placentæ belong to the ventral suture does not hold good, and it must be acknowledged that the position of the placentæ is reducible to no rule, but depends on specific organization, as might be inferred from the anomalous placentation of Cruciferæ, Papaver, Parnassia, &c.

The paper is highly interesting; the reader may refer to it in the *London and Edinburgh Philosophical Magazine*, November, 1837, No. 69.*

VICTORIA REGINA. (GRAY.)

(*See the Frontispiece to the present Volume.*)

THIS newly-discovered magnificent plant has been named in honour of her Majesty; and is thus described in a letter from Dr. Schomburgh to the Botanical Society of London, 17th October, 1837:

The character of grandeur so peculiar to the productions of a tropical sun and a humid climate is highly developed in the object of the above description. The Holy Cyamus or Pythagorean Bean is said to have been derived from a plant closely related to the Nymphaceæ, (Nelumbium speciosum,) and not only that it is highly valued in India and China, and cultivated in large ornamental pots in the gardens and houses of the Mandarins, but it has been held in such high estimation, that at last it was considered sacred. The description and illustrations which have been transmitted to us of this noble plant, have raised the desire of many a botanist to see it in its native country. In my rambles through the West Indian Archipelago, I had frequently met the white water lily; but the remark of an eminent botanist, that these floating plants were entirely unknown on the continent of South America, did not make me expect to find a representative of that tribe, which, for the superior grandeur of its leaves, the beauty of its flowers, and its fragrance, may be classed amongst the grandest productions of the vegetable world. It was on the 1st of January this year, while contending with the difficulties nature opposed in different forms to our progress up the river Berbice, (in British Guiana,) that we arrived at a point where the river expanded and formed a currentless basin. Some object to the southern extremity of this basin attracted my attention. It was impossible to form any idea of what it could be, and, animating the crew to increase the rate of their paddling, shortly afterwards we were opposite the object which had raised my curiosity. A vegetable wonder! all calamities were forgotten, I felt as a botanist, and felt myself rewarded. A gigantic leaf, from five to six feet in diameter; salver-shaped, with a broad rim of light green above, and a vivid crimson below, resting upon the water. Quite in character with the wonderful leaf was the luxuriant flower, consisting of many hundred petals, passing in alternate tints from pure white to rose and pink. The smooth water was covered with them, and I

* Quoted in the Magazine of Popular Science, No. 23.

rowed from one to the other, and observed always something new to admire. The leaf on its surface is of a bright green, in form almost orbiculate, with this exception, opposite its axis, where it is slightly bent up. Its diameter measured from five to six feet; around the whole margin extended a rim about three to five inches high, on the inside light green, like the surface of the leaf; on the outside, like the leaf's lower part, of a bright crimson. The ribs are very prominent, almost an inch high, radiate from a common centre, and consist of eight principal ones, with a great many others branching off from them. These are crossed again by a raised membrane, or bands at right angles, which gives the whole the appearance of a spider's web, and are beset with prickles; the veins contain air-cells like the petiole and flower stem. The divisions of the ribs and bands are visible on the upper surface of the leaf, by which it appears areolated. The young leaf is convolute, and expands but slowly; the prickly stem ascends with the young leaf till it has reached the surface; by the time it is developed its own weight depresses the stem, and it floats now on the water. The stem of the flower is an inch thick near the calix, and is studded with sharp elastic prickles, about three quarters of an inch in length. The calix is four-leaved, each upwards of seven inches in length, and three inches in breadth; at the base they are thick, white inside, reddish brown, and prickly outside. The diameter of the calix is twelve to twenty three inches, on it rests the magnificent flower, which, when fully developed, covers completely the calix with its hundred petals. When it first opens, it is white, and pink in the middle, which spreads over the whole flower, the more it advances in age, and it is generally found the next day of pink-colour. As if to enhance its beauty, it is sweet scented. Like others of its tribe, it possesses a fleshy disk, and the petals and stamen pass gradually into each other, and many petaloid leaves may be observed which have vestiges of another. The petals next to the leaves of the calix are fleshy, and possess air cells, which certainly must contribute to the buoyancy of the flower. The seeds of the many-celled fruit are numerous, and imbedded in a spongy substance. We met them hereafter frequently, and the higher we advanced the more gigantic they became. We measured a leaf which was six feet five inches in diameter, its rim five and a half inches high, and the flower across fifteen inches. The flower is much injured by a beetle, (Trichius. "Spec ?") which destroys completely the inner part of the disk, we have counted sometimes from twenty to thirty in one flower.*

ATOMIC CONSTITUTION OF DEXTRIN.

M. PAYEN has succeeded in determining the atomic constitution of Dextrin, and in showing that this substance, which is fecula in the first degree of disintegration, is isomeric with the sugar from the sugar cane. Dextrin acts on polarized light, causing the plane of polarization to turn to the right, whilst sugar from the grape, into which it is easily converted by the action of acids and other reagents, turns this plane to the left.—*Echo du Monde Savant* †

* Magazine of Zoology and Botany, No. 11.
† Quoted in the Magazine of Popular Science, No. 21.

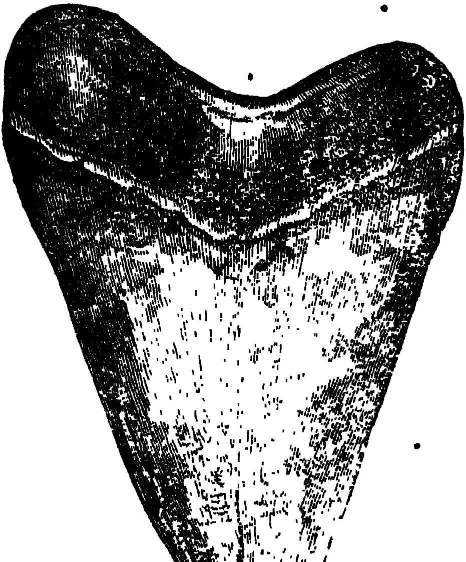
GEOLOGY.

TEETH OF CARCHARIAS MEGALODON OCCURRING IN THE RED CRAG OF SUFFOLK.

By Edward Charlesworth, F. G. S.

THERE are, perhaps, no fossiliferous beds, the history of which, at the present time, involves points of greater interest, than the tertiary formations bordering our eastern coast; and in noticing several of the more remarkable fossils from these deposits, and the conditions under which they occur, it is with the hope of imparting some information respecting them, which may facilitate the researches of others who may feel disposed to enter upon the same field of geological investigation.

Palæontologists will readily recognise in the annexed figure a well-known Maltese fossil, and, perhaps, feel some surprise at the announcement of its occurrence in this country. Within the last few years, however, many specimens of these extraordinary teeth, belonging to a species of the genus Carcharias, probably of gigantic size, have been found on the shore and in the red crag of Suffolk. No other portion of the skeleton has yet been observed, by which we might ascertain how far the general dimensions of the animal correspond to the proportions exhibited by the teeth; nor is it probable that future discoveries in the crag will throw any light upon this point, since the preservation of the dental structures is the only record of the presence of cartilaginous fish during the formation of that deposit. The remains of fish, and of chelonian and saurian reptiles, which are often found in a very complete state in



(Carcharias megalodon: Agass.)

the tertiary trata of Harwich and the Isle of Sheppey, usually owe their preservation to the nodules of indurated clay, which have formed around them. Nothing at all analogous to these nodules occurs in the crag; and, from the very slight consolidation of the beds, and the general lithological character of the deposit, the discovery of connected skeletons can never be expected. All the information that we can acquire, respecting the vertebrated animals whose remains are there embedded, must be derived from the examination of detached bones and teeth. These latter, belonging to various species of the shark tribe, occur in abundance; but, with the exception of the genus Carcharias, all the forms may be identified with those in the London clay; from which deposit it is highly probable that many of them have been removed. The circumstance, however, of specific agreement would not alone lead to the above supposition, since, throughout the whole tertiary series, and even in the more recent secondary rocks, many of the squaloid fish appear to have closely resembled existing types. This affinity is, perhaps, most strongly marked in several species of the genus Lamna, the teeth of which are abundant in the crag and London clay, and are even occasionally met with in some of our lacustrine deposits, associated with fluviatile and land shells. In the coralline beds, and in those marine strata containing the bones of land animals, which have been usually regarded as a part of the crag formation, the teeth of the Carcharias megalodon have not been detected; and they would, therefore, appear to be characteristic of that deposit which extends from Walton, in Essex, along the south coast of Suffolk. As this species has a vertical range from the secondary to the more recent supercretaceous formations, its fossilized remains afford the geologist no assistance in the identification of particular strata, if separated by great horizontal distances. Similar teeth are figured by Dr. Moreton, in his synopsis of the cretaceous fossils of the United States; and they are there said to occur in deposits both of the secondary and tertiary periods. The finest specimens that I have seen are in the Hunterian collection belonging to the College of Surgeons, from the well-known beds at Maestricht; and along with these there is one which has been recently brought over, by Mr. Darwin, from South America. In the Island of Malta, the teeth of this shark have been procured in the greatest abundance; but I am not aware that we possess any definite information respecting the geological relations of the beds in that locality, throughout which these fossils appear so plentifully distributed.

The foreign specimens are usually in a very perfect state; but those from the crag have lost their covering of enamel and serrated edges, probably depending upon the attrition to which they have been subjected. William Colchester, Esq., of Ipswich, whose collection of crag fossils is one of the choicest extant, has in his possession the tooth from which the accompanying figure was made. Specimens are also in the Ipswich Museum, and in the hands of other collectors in Norfolk and Suffolk.*

NEW COAL BEDS.

An extensive coal-field has recently been discovered in the Department of the Saone and Loire, which promises to prove one of the largest in the kingdom; it is situated in the valley Arroux, about a league from Autun.†

* Magazine of Natural History, No. 5.

† L'Echo du Monde Savant; quoted in the Magazine of Popular Science, No. 21.

NEW FOSSIL SPECIES.

M. Eudes Deslongchamps has lately published a memoir on a fossil Saurian, discovered near Caen in 1835, which he proposes to name *Pœkilopleuron Bucklandi*, (*q.d.* varied-ribbed) This animal, which must have been at least from 25 to 30 feet long, must have been intermediate to the crocodiles and lizards. It approximates nearly to the Megalosaurus; nevertheless marked differences in the form of the vertebræ and of the femurs, the only bones of the megalosaurus yet known to us and described, have induced M. Deslongchamps to form another genus of this new animal, characterized by the number and diversity of its ribs. These ribs are, in fact, of different sorts; there are seven, symmetrical, curved like a chevron in the middle, and tapering off at their two extremities, at which their upper surface is channelled out. They were evidently placed on the medial line, in the thickness of the coatings of the abdomen, and resemble the osseus spines which are found in the abdominal muscles of certain lizards, as chameleons, the anoliæ, &c. The Pœkilopleuron had seven other pairs of ribs, or fourteen osseous parts, resembling to a certain degree the former, and which also must have been situated among muscles behind the former, but with this difference, that instead of being united on the median line into one, they were united by means of ligaments. All the abdominal ribs were provided at their extremities with a bony process on the inner face, and attached, for about half their length, in the channel before-mentioned. The seven last pairs of ribs, with their processes, resembled nearly the smaller ribs of the crocodiles.

It would appear from this singular formation, that the inferior portion of the abdomen must have been very extended, and that it must have been fortified with forty-nine bony pieces.

The other portions, collected and collated by M. Deslongchamps, are caudal vertebræ, to the number of twenty-one, a great number of ribs, a pelvis, a femoral bone, a portion of the fibula, four bones of the tarsi, many phalanges, a left humerus, radius, and cubicular bone. The vertebræ have the body slightly concave, both before and behind, and present characters which assimilate them with those of crocodiles and of lizards, without belonging to either of these types.*

PRESENT STATE OF THE NORTH AMERICAN CONTINENT.

On March 22 and April 2, a paper was read to the Geological Society, " On the Ancient State of the North American Continent;" by Thomas Roy, Esq., Civil Engineer, Toronto, Upper Canada.

The author having in the course of his professional duties, discovered in the lake district of Upper Canada terraces or level ridges which agreed in elevation at considerable horizontal distances, he was induced to extend his inquiries and to ascertain how far similar phenomena have been observed in other parts of North America,—what may have been the probable extent of the lake or sea by which the ridges were formed,—and by what operations the waters were drained off, leaving only the present detached Canadian lakes.

With a view to ascertain the probable extent of the sea, Mr. Roy traced upwards from Lake Ontario the successive ridges or terraces,†

* Magazine of Popular Science, No. 14.

† These parallel ridges were exhibited on a section extending obliquely from the mouth of the Niagara to the south of Lake Ontario, and over the ridge north of that lake, to Lake Simcoe.

and ascertained that their greatest height was 762 feet above the lake, or 996 feet above the ocean; he therefore assumed, that the boundary of the ancient sea must have had an elevation of at least 1,000 feet, and in consequence, that it must have been formed on the west by the rocks and mountains ranging from the table-land of Mexico to the parallel of 47° of latitude; on the north by the barrier which separates the head-waters of the lakes from those of the Arctic rivers, and extending to Cape Tourmente below Quebec; on the east by the hills stretching through the United States to the Gulf of Mexico; and on the south by a mountain ridge which has been destroyed. The area thus circumscribed is calculated to be 960,000 square miles.

The chief geological feature connected with Mr. Roy's observations and described in the paper, is the high land which separates Lake Ontario from Lake Simcoe. The distance between these bodies of water is 42 miles, and the greatest elevation of the ridge is 762 feet above Lake Ontario, or 282 above Lake Simcoe. The lowest visible formation is a stratified blue clay which effervesces freely and is of unknown depth. Above this are immense masses of clay, sometimes resembling fuller's earth, and sand most irregularly associated. The central and northern divisions of the ridge are thickly strewed, even to the highest peaks, with a great variety of boulders, many of them of immense size, and for the greater part derived from primary or transition formations. Many of them are rounded, and others decayed by weathering, whilst the edges of some are perfectly entire. On the southern side of the ridge boulders are not so common.

The manner in which the materials composing this ridge are arranged, resembles, in Mr. Roy's opinion, that in which drifted matter is now disposed along the margin of the lakes at the breaking up of the ice; and hence he conceives, that the ridges may, to a considerable extent, have been accumulated in a similar manner.

The author then enters into a calculation of the quantity of water hourly discharged by the Saint Lawrence, the Mississippi and the Hudson, amounting, according to his estimate, to 4,000 millions of cubic feet; and afterwards proceeds to show, that in order to reduce the ancient lake 30 feet, the distance between two of the highest parallel ridges, fifteen years would be required, supposing the discharge to be double that at present.

Mr. Roy next details with considerable minuteness, the processes by which he supposes this vast sea was drained; but as his descriptions cannot be successfully followed without the aid of diagrams, they do not admit of being given in the Society's Proceedings.*

EARTHQUAKE IN SYRIA.

The following are extracts from two letters "On the Earthquake in Syria in January, 1837;" addressed by Mr. Moore, his Majesty's Consul-General at Beyrout, to Viscount Palmerston.

The first letter, dated Beyrout, Jan. 2nd, 1837, announces that the earthquake was felt in that city at thirty-five minutes past four o'clock in the afternoon of the preceding day. It was accompanied by a rumbling noise, which lasted about ten seconds, and appeared to proceed from the north. No buildings were thrown down in the town, but seven or eight without the walls, and one or two lives were lost. In the neighbourhood

* Philosophical Magazine, No. 66.

of Beyrout the course of the river Ontilias was suspended, and mills built on its banks were deprived of water for some hours. When the stream returned it was turbid, and of a reddish sandy colour.

During the day of the earthquake the atmosphere was close and charged with electricity. Fahrenheit's thermometer stood at 66°, but five minutes after the earthquake it rose to 70°. Four or five minutes after the shock the compass was still agitated. The oldest inhabitants did not remember so severe an earthquake.

The second letter was written also at Beyrout, partly on the 9th of January, and partly on the 23rd. It contains detailed accounts of the damage which had been done to numerous towns and villages. At Damascus, four minarets and several houses were thrown down; and at Acre, part of the walls and some buildings. Saffet was entirely destroyed, and nearly all the population, amounting to between four and five thousand, perished. The ground near the city was rent into fearful chasms, and up to the last accounts shocks were felt daily. Tiberias was also entirely destroyed, except the baths; and the lake rose and drowned many of the inhabitants. The dispatch contains a list of thirty-nine villages which had been totally destroyed, and six partially; and Mr. Moore says, it had been ascertained that the earthquake was felt on a line of five hundred miles in length by ninety in breadth. It was also perceived in the island of Cyprus.*

SIR JOHN HERSCHEL, ON THE THEORY OF VOLCANIC PHENOMENA.

The following are extracts from a letter from Sir John F. W. Herschel to C. Lyell, Esq., dated Fredhausen, Cape of Good Hope, 20th February, 1836.

The author commences by inquiring, whether it had ever occurred to Mr. Lyell to speculate on the probable effect of the transfer of pressure from one part to another of the earth's surface by the degradation of existing, and the formation of new, continents, on the fluid or semifluid matter beneath the outer crust? Supposing the whole to float on a sea of lava, the effect would merely be an almost infinitely minute flexure of the strata; but supposing the layer next below the crust to be partly solid and partly fluid, and composed of a mixture of fixed rock, liquid lava and other masses in various degrees of viscidity and mobility; great inequalities may subsist in the distribution of pressure, and the consequences may be local disruptions of the crust where weakest, and escape to the surface of lava, &c.

Referring to the phenomena of volcanos, Sir J. Herschel observes, that it has always been his greatest difficulty in geology to find a *primum mobile* for the volcano, taken as a general and not as a local phenomenon; and referring to the different theories given on the subject, which he considers insufficient, wanting in explicitness and as not going high enough in the inquiry or up to its true beginning, and also as giving in some respects a wrong notion of the process itself;—inquiries, how came the gases which are evolved to be condensed?—why did they submit to be urged into liquefaction?—if they were not originally elastic, but have become so by subterranean heat—whence came the heat, and why did it

* Philosophical Magazine, No. 66.

come ?—how came the pressure to be removed, or what caused the crack ?

It seems clear that if the gases or aqueous vapour were once free at so high a degree of elasticity as is presumed, there exists no adequate cause for their confinement. We are forced therefore to admit that the elastic force has been superadded to them during their sojourn below by an accession of temperature.

Assuming a high central temperature, which many geologists admit, and with which all are familiar; the author agrees with Mr. Lyell's observations, that the ordinary repose of the surface argues a wonderful inertness in the interior, where in fact he conceives that everything is motionless; debarred therefore from the invasion of a circulating current or casual injection of intensely hot liquid matter from below, he conceives that the phenomena may be explained as follows.

Granting an equilibrium of temperature and pressure within the globe, the isothermal strata near the centre will be spherical; but where they approach the surface they will by degrees conform themselves to the configuration of the solid portion, that is, to the bottom of the sea and the surface of continents. If we suppose therefore a state of equilibrium, and that under the concave bottom of any great ocean the lines of equal temperature be parallel to its concavity; when this comes to be filled up by the deposition of matter brought down by rivers, &c., the formerly concave bottom may become horizontal or even convex, and the equilibrium of temperature will immediately be disturbed; because the form of a stratum of temperature depends essentially on the bounding surface of the solid above it, that form being one of the arbitrary functions which enter into its partial differential equation. The temperature, therefore, will immediately begin to migrate from below upwards, and the isothermal strata will gradually change their forms from the concave to the horizontal or convex form. The former bottom of the ocean will then, (after the lapse of ages, and when a fresh state of equilibrium is attained,) acquire a temperature corresponding to its then actual depth; while a point as deep below it, as itself is below the surface, will have acquired a much higher temperature, and may become actually melted, and this without any bodily transfer of matter in a liquid state from below. But if the temperature of this supposed deep stratum be already at the melting point, then will this rise to the former bottom of the ocean and the strata become melted, *water included*, with which, from the circumstances of the case, they must be saturated

If the process of deposition go on, until by accumulation of pressure on the bottom or sloping sides, some support gives way,—a piece of the solid crust breaks down and is plunged into the liquid below, and a crack takes place, extending upwards. Into this the liquid will rise by simple hydrostatic pressure. But as it gains height it is less pressed; and if it attain such a height that the ignited water can become steam, the joint specific gravity of the column is suddenly diminished and up comes a jet of mixed steam and lava; till so much has escaped that the deposited matter takes a fresh bearing, when the evacuation ceases and the crack becomes sealed up.

By taking this view of the process of heating from below, we have a strictly theoretical explanation of the effects of heat on newly deposited strata; and this, simply because the fact of new strata having been deposited, the conditions of the equilibrium of temperature become altered,

and they draw the heat to them, or rather retain it in them in its transit outwards; the supply from the centre being supposed inexhaustible, and its temperature of course invariable.

As the greatest transfer of material to the bottom of the ocean is produced on the coast line by the action of the sea, while the quantity carried down by rivers from the surface of continents is comparatively trifling; hence therefore the greatest local accumulation of pressure is in the central area of deep seas, but the greatest local relief takes place along the abraded coast lines: here, therefore, according to this view should occur the chief volcanic vents.

In this view the effects of the removal of matter from above to below the sea, are, 1st. It produces a mechanical subversion of the equilibrium of pressure. 2nd. It also, and by a different process, produces a subversion of the equilibrium of temperature. The last is the most important. It must be an *exceedingly slow process*, and will depend, 1st. On the depth of matter deposited; 2nd. On the quantity of water retained by it under the great pressure; 3rd. On the tenacity of the incumbent mass—whether the influx of caloric from below, which *must take place*, acting on that water, shall either heave up the whole mass as a continent; or shall *crack* it and escape as a submarine volcano; or shall be suppressed until the main weight of the continually accumulating mass breaks its lateral supports at or near the coast lines, and opens there a chain of volcanos.

Thus the circuit is kept up—the *primum mobile* is the degrading power of the sea and rains, (both originating in the sun's action), above, and the inexhaustible supply of heat from the enormous resources below, always escaping at the surface, unless when repressed by an addition of fresh clothing at any particular part. In this view of the subject the tendency is outwards. Every continent deposited has a propensity to rise again, and the destructive principle is continually counterbalanced by a reorganizing principle from beneath. Nay, it may go further; there may be such a tendency in the globe to swell into froth at its surface, as may maintain its dimensions in spite of its expense of heat, and thus preserve the uniformity of its rotation on its axis.*

[* On the subject of the views here enunciated by Sir John Herschel, see a notice of a paper by Mr. Babbage, Lond. and Edinb. Phil. Mag. vol. v. p. 213. Mr. Babbage has since published the substance of his paper in his work entitled "The Ninth Bridgewater Treatise," together with the extracts from Sir J. Herschel's letters, abstracted above. He observes, in reference to the similarity of Sir J. Herschel's views to those he had himself previously started. "I feel, that the almost perfect coincidence of his views with my own, gives additional support to the explanations I have offered; whilst the reader will perceive, from the different light in which my friend has viewed the subject, that we were both independently led to the same inferences by different courses of inquiry." —Editor of the Philosophical Magazine.]

Next is an extract of a letter from Sir John F. W. Herschel to R. I. Murchison, Esq., in explanation of the former, to C. Lyell, Esq., dated Fredhausen, 15th November, 1836.

In this letter the author recapitulates the views given in the foregoing abstract, stating that his views are not so much a theory as a pursuing into its consequences, according to admitted laws, of the hypothesis of a high central temperature; and his object to get a geological *primum mobile* in the nature of a *vera causa*, and to trace its workings in a distinct

and intelligible manner, so that in future, instead of saying as heretofore, "*Let heat* from below *invade* newly deposited strata, then they will expand, melt," &c., we shall commence a step higher, and say, "*Let strata be deposited*, then, as a necessary consequence, and according to known regular and calculable laws, heat will gradually invade them from below and around; and according to its due degree of intensity at any assigned time will expand or melt them as the case may be," &c. The phenomena of earthquakes, volcanic explosions, &c., may arise, but if all goes on in quiet, the only consequences will be the obliteration of organic remains and lines of stratification, and the formation of new combinations of a chemical nature, &c.; in a word, the production of *metamorphic* or stratified primary rocks.

In the formation of these therefore there is nothing casual; all strata once buried deep enough, and due time allowed, must assume that state. None can escape; all records of former worlds must ultimately perish.*

FOSSIL FISHES IN THE LANCASHIRE COAL FIELD.

On November 1, a letter "On Fossil Fishes in the Lancashire Coal Field," by W. C. Williamson, Esq., Curator of the Manchester Natural History Society, was read to the Geological Society.

The author first refers to his account of the Ardwick Limestone, published in the Philosophical Magazine for 1836,* where short descriptions are given of the ichthyolites which had been then met with, consisting of scales of Megalichthys, scales and teeth of Palæoniscus and coprolites. Mr. Williamson, in conjunction with Professor Johnstone, has since come to the conclusion, that the bed in which these remains occur is entirely a coprolitic mass, the portions preserved being such as would not be destroyed by the action of the stomach. With the above remains was also described a tooth of *Diplodus gibbosus*, (Agassiz,) numbers of which of various sizes have been found at Bradford, near Manchester, in the roof of the great mine, a coal four feet thick, almost the highest in the series that is worked; and the roofstone is almost entirely composed of Entomostracous remains. The teeth resemble one figured by Dr. Hibbert in his Memoir on the Limestone at Burdie-house, and referred by him to Gyracanthus. The author has met with no traces of the thorny ray of this fish. The coprolites contain 72·5 phosphate of lime, 12·5 carbonate of lime, 12·5 bitumen, 2·5 insoluble matter; resembling the analysis given by Dr. Hibbert.

The author, in examining, at Peel, near Worsley, the "Black and White Mine," a coal 6 feet 6 inches thick, and about 1,000 yards below the Rodte Todte Liegende, found, in its black roofstone, remains of *Palæoniscus Egertonii*. The fine blue colour of the scales forms a curious characteristic. Two other forms of scales have been met with, evidently belonging to distinct species of fish; one is small, rhomboidal, and coated with a bright enamel; the other is peculiar from the mucronate and grooved character of one extremity, and the cycloid outline of the other. At the same place were found scales resembling those of Megalichthys, several small teeth of *Diplodus gibbosus*, and several osseous portions of some large fish not yet determined. Near Ringley, about five miles from Peel, the same roofstone was found in another pit, which the author has not yet further examined; but in both pits one or two species

* Philosophical Magazine, No. 66.

* Philosophical Magazine, vol. ix. p. 241.

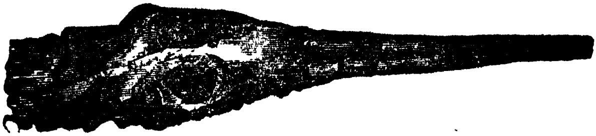
of Unio occur, as well as remains of *Stigmaria, ficoides, Calamites, nodosus*, and other plants.*

COAL DEPOSITS OF ENGLAND.

At the late meeting of the British Association, Dr. W. H. Crook observed on the unity of the Coal Deposits of England, that the coal-fields of England and Wales were not *distinct* basins, but that the supposed basins were only portions which had been detached and elevated by the agency of syenitic and trap rocks, of a much larger deposit, spread over the greater part of the districts now covered by the new red sandstone. Of the vegetable origin of coal there is now no doubt: the only question unsettled is, did the plants supplying it grow on the spots where it is found, or were they *transported*? Dr. Crook inclined to the latter opinion, and conceives that this view may be extended to the coal of Belgium, of the north of France, and the north-west of Germany; the carboniferous beds of those countries having, originated, in his opinion, in a drift of vegetable substances, from countries lying to the east or E.S.E. of them; and he also thought, that the extent and richness of the English coal-fields, especially in the Midland counties, arose in a considerable degree from the impediments offered to the transit of the drifted matter by the slate and other ancient formations of Wales and Cumberland. He considered, that the Charnwood Forest rocks had elevated the coal-field near it, and a similar elevation had taken place at Nuneaton.

Mr. Greenough considered the idea of Dr. Crook as very probable; but observed, that the deepest of our coal basins had been found to be in South Wales.—Mr. Young, from Nova Scotia, stated, that large deposits of coal had been found in that country.†

FOSSIL CROCODILE.



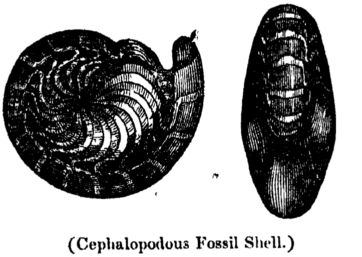
The Engraving represents the head of a crocodile (? *Steneosaurus*,) lately discovered in the lias at Whitby, Yorkshire; it is a very perfect specimen, 8½ feet long. Mr. Charlesworth believes Whitby to be the only *lias* locality in which the skeletons of crocodiles have been discovered in this country; and as the number of specimens hitherto found is very small, every additional one is worth recording. The Museum at Whitby has the finest specimen of fossil crocodile known, 15½ feet long; from 2 to 3 additional feet being wanting to complete its jaws.‡

* Philosophical Magazine, No. 72.

† Athenæum, No. 517; quoted in the Philosophical Magazine, No. 72.

‡ Magazine of Natural History, No. 10

CEPHALOPODOUS FOSSIL SHELL.



(Cephalopodous Fossil Shell.)

THE specimen here figured, certainly the rarest and most interesting of the species of this genus which occur in the London clay, has been procured by Mr. Whetherall of Highgate, from the railway tunnel at Primrose Hill. In the *Mineral Conchology*, we find at tab. 1. fig. 4. a representation of an imperfect specimen of this truly elegant fossil, under the name of Nautilus ziczac; but Mr. Sowerby does not notice the remarkable character of its chambers, except as a ready means of distinguishing the species. The sinous septa, so beautifully shown in this specimen, from the loss of the external coat, would place this species in that division of fossil multilocular shells to which the term Goniatite has been applied by Von Buch, were not the siphunculus placed along the internal margin. The characters of this shell, indeed, will not admit of its being placed in either the genus Nautilus or Ammonites, as will be seen by a reference to the following characters of the families Nautilidæ and Ammonitidæ, in the article Cephalopoda, by Mr. Owen, recently published in *Todd's Cyclopædia of Anatomy and Physiology:*

Fam 1. Nautilidæ. Shell external, spiral, or straight; septa smooth simple; the last chamber the largest, and containing the animal; siphon central or marginal and internal.

Fam. 2. Ammonitidæ. Shell external, spiral, or straight; septa sinuous and with lobated margins; the last chamber the largest, and lodging the animal; siphon central or marginal and external.

Now, it is clear that the specimen before us is neither Nautilus nor Ammonite; for we are here presented with *sinuous* septa, whilst the siphuncle is marginal and internal.

The following may be given as its characters:—

Shell involute; inner whorls concealed as in Nautilus; septa with deep lateral narrow sinuosities; siphuncle continuous, marginal, and internal.

These characters might, perhaps, be thought by some sufficiently tangible to establish a genus for the reception of Nautilus ziczac; but Mr Charlesworth does not consider himself warranted in so doing, because he is aware of the existence of a fossil also from the London clay, and which is figured by Mr. Parkinson (*Organic Remains*, vol. iii.), in which the septa are like those of N. ziczac, but the siphuncle is not marginal This specimen, which is of large size, is now in the possession of Mr. James De C. Sowerby.

Two points are involved in the History of this fossil, and the other to which reference has been made, which are well worthy of attention (connected with their zoological characters, and the conditions under which they are found). The position of the siphunculus in the chambered cephalopodous shells appears to be of less value as a generic character than has been hitherto imagined; and, secondly, it seems that Goniatites, or at any rate something very like them occur in the London

clay, a bed in which we certainly should not have anticipated their existence.

Although the true Nautili are rather plentifully met with when any considerable excavations are made in the neighbourhood of the Metropolis, the species of this genus are by no means abundant throughout the whole extent of the clay deposit overlying the chalk. They are rather numerous in the Isle of Sheppey, and Mr. Charlesworth has occasionally seen very fine specimens in the cliffs of Essex and Suffolk; but he has never detected a fragment of a Nautilus in that rich deposit of tertiary fossils on the Hampshire coast, nor is he aware that it ever occurs there. As the genus is unknown in either the coralline or red crag as a tertiary fossil in this country, it is characteristic of the London clay. Mr. Bowerbank has one specimen of N. ziczac from Sheppey, and Mr. Sowerby's specimen was from Highgate. The one figured here (by far the most perfect specimen of the three) was obtained from a labourer at the Primrose Hill tunnel.*

ON THE INCREASE OF TEMPERATURE IN THE INTERIOR OF THE EARTH.

M. Arago has lately communicated to the Academy of Sciences the result of the thermometrical observations which he made on the 1st of May last in the well which is now being sunk at the slaughter-house (Abattoir) of Grenelle. The boring has now reached the depth of 1,312 English feet. The bed of chalk, in which they have for so long been engaged, is not yet traversed, but the numerous flints, which were unceasingly met with at lesser depths, have now disappeared. The city of Paris has determined that the boring shall continue to the depth of 2,295 English feet, if the spouting water be not found sooner. It is presumed that the water which will issue from so great a depth will possess a temperature of between 93.°2 and 95° Fahr., and, in that case, it might be employed for hot-baths, &c. But however this may be, we shall now adduce the thermometrical observations which have been made at the depth of 1,312 English feet. On the 29th of April, at 7 P.M., four instruments were sent down, viz. two of M. Buten's self-registering thermometers, one a *diversement* thermometer, which M. Magus of Berlin had recently sent to M. Dulong, and another of the same construction manufactured by M. Walferdin. The two first were contained in a copper tube, in which they were secure from the pressure of water; the third was open at the top, but in such a manner that the pressure could not alter its form; and the fourth was inclosed in a glass tube, which was hermetically sealed. These four instruments, after having remained for about thirty-six hours in the well or bore, were removed from it on the 1st of May, about 7 A.M.; they then indicated the following temperatures:—

The first thermometrographe of M. Buten..	74°.3
The second, do.	74° 21
M. Magus' thermometer, a diversement	74°.30
M. Walferdin's do.	74°.66

Assuming, then, 74°.3 Fahr. as the temperature at the depth of 1,312 English feet, if you subtract from this number that of 51°.08 Fahr., which

* Mr. Charlesworth; in the Magazine of Natural History, No. 10.

indicates the mean temperature of the surface of the earth at Paris, 23°.22 will remain for the increase of temperature, corresponding to 1,312 English feet of depth, or what comes to the same thing, 1°.8 Fah. for 101.2 English feet. If we take the case of the observatory as the starting point for the temperature where it is 53°.06 Fah., 21.°24 Fah. will then be given as the augmentation for 1,222.5 English feet, which corresponds to 103.348 English feet for each centigrade degree.*

MUD VOLCANOES.

In the proceedings of the Geological Society of France, it is mentioned that M. De Verneuil had visited the peninsula of Caman, and the eastern portion of the Crimea where the small village of Kertsch is situated, a district covered by hills which owe their origin to muddy eruptions, generally accompanied by springs of naphtha and by springs of muddy water which evolve gas; they have a height of from 200 to 300 feet above the level of the plains. Their flanks are for the most part furrowed by deep crevices, produced by the action of the waters of the atmosphere on substances having but little solidity. At the summit there occur small cavities, from an inch to three feet in depth, and having the form of craters, which are constantly bringing to the surface a small quantity of muddy water. Gas is frequently disengaged from this water; and sometimes on the continuation of the hill there occur springs of bitumen, which are so abundant, that M. de Verneuil has counted forty points whence naphtha was obtained in buckets like water. An eruption, which lasted six hours, had been preceded during three days by subterranean reports resembling discharges of artillery. Portions of black earth, which assumed a variety of forms, were projected to a height of from five to six toises. A smoke, or rather a gas, having a bituminous and sulphurous odour was uninterruptedly emitted, and at intervals jets of flame were perceived. At the distance of a few toises, the earth seemed to move under the feet of the spectator.†

CYPRÆCASSIS, A PROPOSED NEW GENUS OF UNIVALVE SHELLS, FOR THE RECEPTION OF CERTAIN SPECIES OF BRUGIERE'S GENUS CASSIS.

By Samuel Stutchbury, Esq., A.L.S.

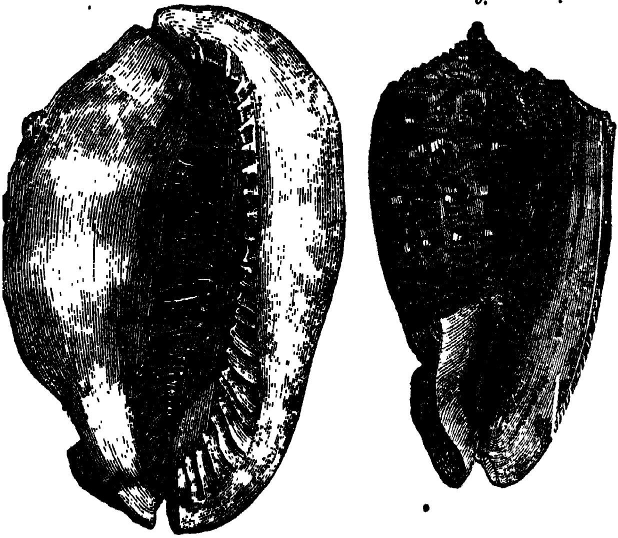
CYPRÆCASSIS.

Shell, when young striated, reticulated, or tuberculated; outer lip simple; *when mature*, outer lip involute, and toothed; columella lip also toothed; aperture straight, anteriorly terminated by a recurved canal, posteriorly by a shallow channel. Animal with the mantle bilobed; operculum none.

The above genus has hitherto been confounded with Cassis, and, in the form of their shells, a considerable analogy certainly exists; but it will be found that these genera differ in the following important characters:—The true Cassides possess no operculum; and the animal by means of its mantle, completes the mouth in the young shells, at each separate period of growth, as perfectly as in the most mature; protecting the upper portion of the shell by an epidermis: while, on the contrary, the genus before us never forms or completes its outer lip but once during its life; consequently,

* Jameson's Journal, No. 47. † Ibid.

a. b.



(*Cypræcassis rufa: a,* mature; *b,* immature.)

it is destitute of varices. It has, also no epidermis, nor is it furnished with an operculum. In the latter characters it approaches much nearer to the Cypræadæ, than to the Cassides.

Taking the Cassis rufa as the type of our new genus, upon comparing it with Cypræa, and particularly with those divisions of that genus which are denoted by being rough on the upper surface, including the striated and pustulated species, we shall find in its shell such an affinity to these latter, that, independently of the distinctness of its animal from that inhabiting the true Cassides, we are only surprised that an examination of the shell alone should not have attracted the attention of Conchologists to the necessity of making the present separation.

The principal distinction between this genus and Cypræa consists in the two lobes of the mantle of the animal not meeting on the dorsum of the shell. Had the lobes of the pallium in C. rufa extended so far as to have covered the whole of the shell, as we find to be the case with nearly all the cowries, the deposit of a smooth enamel-like coat, similar to that of the inferior or basal surface, would then have extended itself over the rough surface of the upper portion, or dorsum, including the recurved beak, or canal, and nearly obliterating the spire; would, in fact, have made it a perfect Cypræa.

It may be observed, in many species of Cypræa that, after a certain age, the dorsal line which marked the division of the two lobes of the mantle (so well exemplified in Cypræa mappa) is obliterated, and that the basal edges become much thickened. This is well exhibited in Cypræa caput serpentis, vitellus, and most particularly in adult specimens of caurica. In these cases, the mantle of the animal is in precisely the same circumstances

as in the typical species of our genus; with this difference only: we suspect in Cypræcassis the lobes of the animal never entirely enveloped the shell, while in Cypræa caurica, and others, the animal was capable of enveloping the shell while it retained its cylindrial form, but not after it began to expand laterally.*

The above specified distinguishing characters we think quite sufficient to justify us in creating a genus for the reception of that division of the genus Cassis denoted by the total want of varices, the absence of an epidermal covering, and also in being deficient of an operculum.

COAL-FINDING.

In the mysterious business of coal-finding, we are warranted in making any reasonable experiments which may lead to a recovery of the range of the whole series of coal measures, and in drawing inferences for our guidance in the choice of places of trial, from the most remote phenomena which seem to favour our purpose; for the seemingly abrupt terminations of some of our coal-fields are certainly the most difficult problems in geology. Here, the practical man, with a vast field of experience by the side of him, is at a loss how to proceed. What, therefore, has he to do but to seek out all the analogous cases, and, even if not strictly analogous, to learn, if he can, by the known the way to the unknown

Now, there are certain *partial interruptions* to the regular courses of the coal-beds in the great northern run of the coal-measures which extends through Derbyshire and Yorkshire, which may help to elucidate the mysteries at the two extremities of that long coal district, and to satisfy us whether they really are terminations, or only great and unusual deflections in the ranges of those strata, deeply hidden and unexplored, and which, better known, (perhaps only by experiment.) may enable us to judge of the probability of uniting or extending our coal-fields.

For solving these important questions on our coal-fields, some few years since noticed by Mr. Coneybeare in a very general way, (not altogether correct,) I think much may be deduced, both from the observations of the geological phenomena, and from experience.

Some are certainly not extricable in the direction of their ranges, while others appear to be so; and, therefore, there is a probability of some of them being united.

Some of the coal-fields, particularly in the middle of the island, seem not yet wrought to any well defined limits of the coal series; and, consequently, in such cases there is good ground for expecting an extension; and especially as geology, by its settled order of superposition in the rocks, does away old erroneous notions of cut-offs, &c., by the red rock, and by the interposition of faults or dikes.

From the numerous instances of now well-ascertained undulations across the general ranges of the strata, by which their planes are formed into caverns, and, intermediately, in the reverse of these forms, so that the strata of coal may rise on one side up to an unconformable covering, cut off by the red marl or red rock, there may be good reason to expect the coal measures to go down again on the other side of the so-called anticlinal line at no great distance; and especially where it can be ascertained that such lateral

* Magazine of Natural History, No. 4, N. S.

rise of the strata has not brought up the deepest part of the coal series; but, where the millstone girt or mountain limestone appears, there, with certain exceptions, the case may be decisive.

That there are such opposite lateral rises and dips in the strata, where the coal-measures are deeply unconformably covered by the red marl, is well known in the extensively wrought collieries of Somersetshire, (where I commenced my studies of geology;) and, consequently, the planes of the coal are subject to hollows and ridges, though the extent of these irregularities may not yet be known.

We see that the strata, in part, or in whole series of strata in their superficial exposures, form such natural hollows and ridges to a great extent, chiefly across the bearings of their ranges; and, therefore, *we have a right to expect such forms in them, even where they are deeply covered.*

The broad and very long coal-field of South Wales terminates north and south with opposite rises in the strata.

The coal in Durham rises, in its southward boundary, nearer to the surface; so that good coal is found at no great depth beneath its unconformable cover of magnesian limestone.

The northernmost coal of Yorkshire rises northward beneath a cover of the same limestone, and ranges E. and W.; forming, with its south-western boundary, a westerly pointed figure, widening and deepening south-eastward.

The question of an east or north-easterly continuation of the coal-measures can only be entertained at the easterly end of the east and west range, before mentioned; but we must previously turn to other places, to see, by analogy, how far any subterraneous deflection in the range of the coal-measures may be thereabout expected.

Along the westerly edge of the coal-measures, both in Yorkshire and Derbyshire, there are well-known irregularities occasioned by elevations and depressions across the general range of the series, causing sinuosities in the marginal edges of the coal-fields. The lands eastward, over the ridges, contract, and those westward, in the hollows, expand the width of the coal-measures; so that the first rise in the north side of the Dun causes a vacant space between Sheffield and Chapel-town; and the second rise south of Sheffield, and in Derbyshire, causes a vacant space in the productive coal-measures between the high part of Sheffield Park and Coal Aston; and in the hollow between these two ridges the coal is thrown back under Sheffield. But there is a greater westward receding in the Dronfield trough, one side of which, rising to the north, causes a long east and west range through Coal Aston.

We have, therefore, north and south of the Dun, two east and west ranging lines of the coal-measures, (similar to, but much shorter than, that on the north side of the Yorkshire coal-field,) from which two east and west ranging lines the coal is known, in both cases, to return and resume its regular course.

That in Derbyshire, from Eckington to Stubly, is several miles in extent: but it is not from the magnitude, but from the similarity, of these irregularities, that we may infer the probability of the coal-measures, in class of the most northerly works in Yorkshire, continuing easterly or resuming a north or north-easterly range, though it may be at a great distance beneath their unconformably covering strata.*

* Magazine of Natural History. No. 12.

THE DINOTHERIUM GIGANTEUM.

FRAGMENTS of the bones of this remarkable fossil and extinct species have been found in several parts of France, in Bavaria, and in Austria; the most abundant remains were found at Applesheim, in the province of Hesse Darmstadt, where an entire head, represented below, and the most perfect specimen hitherto found, was discovered in the autumn of 1836 The Applesheim bones were found in a sand pit along with marine shells, and those from France in a fresh-water tertiary limestone. It is described as having been one of the largest of the land mammalia, to have attained the length of eighteen feet, and according to Cuvier and Dr. Buckland, as closely allied to the tapir. Dr. Buckland in his Bridgewater Treatise (vol. i. pp. 137-8) thus states his opinion respecting its habits:—

(Head of the Dinotherium Giganteum.)

"I shall confine my present remarks to this peculiarity in the position of the tusks, and endeavour to show how far these organs illustrate the habits of the extinct animals in which they are found. It is mechanically impossible that a lower jaw, nearly four feet long, loaded with such heavy tusks at its extremity, could have been otherwise than cumbrous and inconvenient to a quadruped living on dry land. No such disadvantage would have attended this structure in a large animal destined to live in water; and the aquatic habits of the family of Tapirs, to which the Dinotherium was most nearly allied, render it probable, that, like them, it was an inhabitant of fresh-water lakes and rivers. To an animal of such habits, the weight of the tusks sustained in water would have been no source of inconvenience; and, if we suppose them to have been employed as instruments for raking and grubbing up by the roots large aquatic vegetables from the bottom, they would, under such service, combine the mechanical powers of the pick-axe with those of the horse-harrow of modern husbandry. The weight of the head, placed above these downward tusks, would add to their efficiency for the service here supposed, as the power of the harrow is increased by being loaded with weights.

"The tusks of the Dinotherium may also have been applied with mechanical advantage to hook on the head of the animal to the bank, with the nostrils sustained above the water, so as to breathe securely during sleep, whilst the body remained floating at perfect ease beneath the surface; the animal might thus repose, moored to the margin of a lake or river, without the slightest muscular exertion, the weight of the head and body tending to fix and keep the tusks fast anchored in the substance of the bank; as the weight of the body of a sleeping bird keeps the claws clasped firmly around its perch. These tusks might have been further used, like those in the upper jaw of the Walrus, to assist in dragging the body out of the water, and also as formidable instruments of defence.

"The structure of the scapula, already noticed, seems to show that the fore leg was adapted to co-operate with the tusks and teeth, in digging and separating large vegetables from the bottom. The great length attributed to the body would have been no way inconvenient to an animal living in the water, but attended with much mechanical disadvantage to so weighty a quadruped upon land. In all these characters of a gigantic, herbivorous, aquatic quadruped, we recognise adaptations to the lacustrine condition of the earth during that portion of the tertiary periods, to which the existence of these seemingly anomalous creatures appears to have been limited."

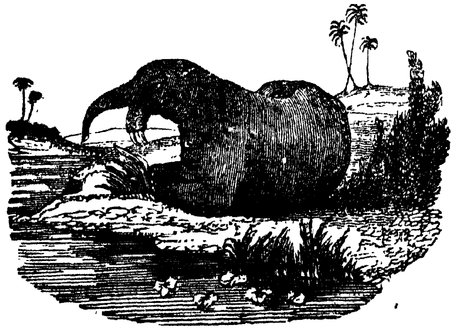
The head here represented of the Dinotherium Giganteum has been carried to Paris, and submitted to the examination of French naturalists. At a meeting of the Academy of Sciences on the 26th of March, 1837, Mr. Blainville read a communication detailing his views, in which he says:—

"The Dinotherium was an animal of the family of the Lamantins or Aquatic Gravigrades, its proper position being at the head of the family, preceding the Dugong, and consequently proceeded by the Tetracaulodon, which ought to terminate the family of the elephants. In a word, the animal in our opinion, was a Dugong with tusk-incisors. We must then suppose that it had only one pair of anterior limbs, and five toes on each. As to the supposition that the animal was provided with a trunk, which might be presumed from the great nasal opening, the enlarged surfaces which surround it, and the size of the suborbital nerve, as far as it may be judged of from the size of the suborbital hole, we believe that is at least doubtful, and that it is more probable that these dispositions bear relation to a considerable developement of the upper lip, and the necessary modification of the nostrils in an aquatic animal, as is equally the case in the Dugong."

More lately, M. Kaup, the discoverer of the Dinotherium Giganteum, who, in his work entitled "Das Theirreich," placed this fossil genus in the order *Edentata*, has reconsidered his former opinion; and in a letter in the *Comptes Rendus* for April, 1837, proposes the following modification of it:—

"M. Kaup writes that the observations on the *Dinotherium*, which were presented by Messrs. de Blainville, Isodore Geoffroy St. Hiliare, and Dumeril, at the meeting of the Academy of Sciences, on the 20th of March last, had led him afresh to examine the subject; and hence, thanks to the means of comparison supplied in the superb Gallery of Comparative Anatomy, he had been enabled to satisfy himself that the alliances which he had first established between the animal and the *Edentata* were grounded upon deceptive appearances. I now recognise, says M. Kaup, that the two phalanges which I conceived I might refer to the *Dinotherium*, belonged to some other animal, which, without doubt, should be classed as a genus approaching to the *Pangolines* or *Orycteropes*; but in adopting upon this point the opinion first advanced by Baron Cuvier, and which M. de Blainville has alluded to in his communication, I cannot see in the Dinotherium, as does this latter naturalist, an animal which very nearly approximates to the *Dugongs*. On the other hand, I think it must be placed among the Pachyderma properly so called, and in a genus very closely allied to the Hippopotamus. I shall state, in a few words, the reasons which induce me to think that the *Dinotherium*

should not be arranged under the order Cetacea, but rather among the Pachyderma. 1st, The texture of the bones of the Cetacea differs completely from that of the Dinotherium; it is more fibrous, whilst in the bones of this animal it is harder, as in the pachyderma generally. 2nd, The occipital bones of the cetacea present something like fontanells, which are especially remarkable in the neighbourhood of the basilar bone; whilst nothing of this sort is seen in the head of the *Dinotherium.* The *pars petrosa* of this last, which exhibits the same structure as in the pachyderma, is placed at the extremity of a long auditory canal, as in the hippopotamus, and consequently is not found situated on the level of the external face of the occipitals, as occurs in the dugongs, in which it forms a portion which is almost wholly isolated. 3rd, As to the form, structure, number, and mode of replacement of the teeth, the *Dinotherium* is evidently one of the Pachyderma; and in this respect it has not the slightest analogy with the Manatee, and still less with the Dugongs. 4th, If the angle which the frontal bones forms with the back part of the cranium be excepted, there will be found in this last part, as M. Laurillard has remarked, much more resemblance with what we observe in the rhinoceros, than with what is found in any other animal. But this obtuse angle, which I also find in the Cete properly so called, as I have formerly remarked, does not at all exist in the Dugong, in which this angle is



(The Dinotherium Giganteum restored.)

almost a right one, as in the other Mammalia. 5th, The exterior form of the basilar bone, and of the bones which surround it, as well as that of the suborbital foramina, are entirely different from what is observed in the dugong, and exactly resembles that which is seen in the pachyderma. The same is also true of the prolongation in form of an epiphysis, which is found behind the glenoid cavity, or rather the facet which forms the articulation of the lower jaw; there is no analogy to this except in the pachyderma. 6th, The zygomatic arch, so far as we can judge of it by the portions of it which have been preserved, resemble those of the rhinoceros; in the dugong it is much more arched.—As to the cervical vertebræ of the animal approximating the dugong, which is mentioned in the Catalogue of Fossiles of M. de Klipstein,—a vertebra which M. de Blainville alludes to as having possibly belonged to the *Dinotherium,* it

belongs to an animal of the same size as the manatus, and consequently cannot have formed a part of the body of the *Dinotherium*; it belongs to a new genus, nearer to the manatus than the dugong, to which I have given the name of *Pugmeodon*; the animal is undoubtedly identical with that which has been described by M. Duvernoy, and the same also as the fossil manatus described by Baron Cuvier. The formation in which the bones of this animal is found is murine, and all the vertebræ are filled with the teeth of the shark.

Annexed is a representation of the restored dinotherium as given by Kaup.

M. Strauss, a German naturalist, is not disposed to the opinions of Buckland or Kaup, but proposes one of the same general nature with that of Blainville.

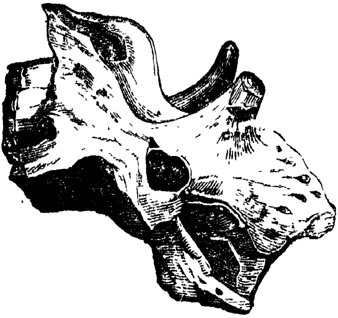
THE SIVATHERIUM.

The fossil remains of this new genus were discovered in tertiary-strata in the valley of the Markanda, in the Sivalik branch of the Sub-Himalayan Mountains, associated with bones of the fossil elephant, mastodon, rhinoceros. hippopotamus, &c., by two meritorious officers, Dr. Hugh Falconer and Captain P. T. Cautley, who have published an interesting account of their investigations in the First Part of the Nineteenth Volume of the Asiatic Researches, printed at Calcutta in 1836. From the details of these officers, it cannot be doubted that the Sivatherium belongs to a genus now, for the first time made known to naturalists. Some difference of opinion has arisen as to the place which this newly discovered animal should occupy in the zoological system. Messrs. Falconer and Cautley remark,

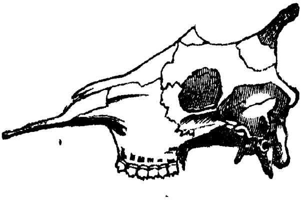
"That the Sivatherium was a very remarkable animal, and fills up an important blank in the interval between the Ruminantia and the Pachydermata. That it was a ruminant, its teeth and horns clearly establish; and the structure which we have inferred of the upper lip, its being a proboscis, the osteology of the face, and the size and position of the orbit, approximate it to the Pachydermata. The circumstance of any thing approaching a proboscis is so abnormal for a ruminant, that, at first view, it might raise a doubt regarding the correctness of the ordinal position assigned to the fossil; but, when we inquire farther, the difficulty ceases. In the Pachydermata, there are genera with a trunk, and others without a trace of it. This organ is therefore not essential to the constitution of the order, but accidental to the size of the head, or habits of the animal, in certain genera. Thus, in the elephant, Nature has given a short neck to support the huge head, the enormous tusks, and the large grinding apparatus of the animal; and, by such an arrangement, the construction of the rest of the frame is saved from the disturbance which a long neck would have entailed. But, as the lever of the head becomes shortened, some other method of reaching its food becomes necessary; and a trunk was appended to the mouth. We have only to apply analogous conditions to a ruminant, and a trunk is equally required In fact, the camel exhibits a rudimentary form of this organ, under different circumstances. The upper lip is cleft; each of the divisions is separately movable and extensible, so as to be an excellent organ of touch."

Jameson's Journal, No. 45.

Geoffroy de St. Hilaire, on the contrary, maintains that it belongs to the Giraffe tribe, an opinion rejected by M. de Blainville, who remarks that



(Sivatherium Giganteum.)



(Giraffe.)

there is no other semblance between the Sivatherium and the Giraffe than that which belongs to animals of the same order of ruminants, as is evident on comparing the figure of the head of the Sivatherium, as given by Messrs. Falconer and Cautley, with that of the Giraffe.*

NEW FOSSIL REPTILE.

DR. MANTELL has lately obtained from a quarry in Tilgate Forest, a considerable portion of the vertebral column of the *hyleosaurus*; that extraordinary reptile which was furnished with enormous spines along the back. In this specimen there are upwards of twenty vertebræ, consisting of the lumbar and many of the caudal vertebræ, together with portions of the large spines, and many small dermal bones. The chevron bones present considerable variety in form, according to the position they hold in the series. The first caudal vertebræ have chevron bones resembling those of the crocodile; in the middle of the tail the chevrons are hatchet-shaped; and towards the extremity they become of an elongated form. The transverse processes of the lumbar and first caudal vertebræ are very long, and the spinous processes short; the tail, therefore, must have been wide transversely, and not in a vertical direction, as in the crocodile.†

* Jameson's Journal, No. 45.
† Literary Gazette, No. 1066.

ASTRONOMICAL AND METEOROLOGICAL PHENOMENA.

AURORA BOREALIS.

On February 27, Professor Lloyd read, before the Royal Irish Academy, a note on the Aurora Borealis of the 18th inst., of which the following is an extract:—

"At a quarter past ten o'clock on the night of the 18th inst., my attention was called to a remarkable ruddy appearance in the eastern part of the sky, which, at first view, seemed to arise from the reflection of a fire. On a more attentive examination, however, it was soon evident that the appearance was purely meteoric. It was, in fact, an auroral phenomenon, though of a very peculiar kind.

"It was bright moonlight, and Mars had just appeared after his occultation by the moon. The sky was entirely without clouds; but the northern, eastern, and western segments, were covered with a curtain of diffused Aurora, resembling a luminous vapour. This curtain was lifted from the horizon on the east and west, and exhibited a deep blue sky. But the distinguishing appearance was, that large masses of this light, especially towards the east and north-east, were of a *blood-red* colour, which presented a vivid contrast to the blue of the sky beneath. A large patch of this red light, about 40° from the horizon to the eastward, was the most remarkable. It continued distinctly visible for upwards of half an hour; and its motion was so rapid, that in this time it had advanced from about due east to a point nearly south-east.

"There was a mass of *white* streamers to the north, which reached nearly to the zenith, and pointed somewhere between the magnetic and due north. At half-past ten o'clock, a brilliant and well-defined stream of light, of the blood-red colour, appeared a little to the south of west, and seemed to be a disjointed portion of the eastern red mass. A few minutes after its appearance, a large mass of white auroral light began to rise rapidly from the northern horizon; at the same time the northern streamers became much more vivid, and took a fan-like appearance, converging to a point not far from the zenith. There was no appearance, however, of *Corona*. Shortly after, (about $10^h 40^m$,) a portion of the light of these streamers, about midway between α Ursæ and Polaris, assumed the unusual blood-red tint, and continued of this colour for several minutes.

"Before eleven o'clock all the peculiar appearances had nearly gone; and there remained nothing but the faint luminous clouds, with light streamers to the N.N.W. These streamers were still playing at twelve o'clock, and extended from the zenith to within about 30° of horizon.

"The thermometer stood at 38° Fahr., and the barometer at 29 786 inches. The wind was dry and piercing."

The following note, by Mr. Bergin, supplies the account of the early part of the phenomenon:—

"On alighting at the Dunleary station at seven o'clock, (from the Railway,) we observed a magnificenly coloured crimson Aurora as a broad mass to the westward; and our first impression for a moment was, that it was the light from one of the engine furnaces reflected from a cloud of steam. It extended from near the horizon towards the zenith, with frequent flashes or streamers within itself. From the main mass, round by the north, and onward to the east, the whole sky had a crimson or carmine tint; and were it not for the brilliant moon (near the fall) I do believe the splendour would have equalled any I have ever heard of. * * * * The Aurora assumed the general appearance of an arch; the first observed mass to the westward being one leg which faded away towards the zenith, where there was a steady circular patch of great brilliancy of colour, and from thence, separated by a small interval, was a faint limb descending to the eastern horizon. * * * * These appearances continued with scarcely any change till near eight o'clock. About nine o'clock the general appearances were much the same, save that the easterm limb of the arch was not visible, and the western much more intensely coloured, and like a steady colmn. * * * * Throughout, its limits had been well defined; and it was perfectly transparent, stars of the third, and, perhaps, the fourth magnitude, being seen through it."*

AURORA BOREALIS IN LONDON.

SUNDAY, the 12th of November, was remarkably fine, a cold wind which blew from the NW. in the early part of the day declined in the afternoon, and the sun set with a splendour, in a nearly cloudless sky, that is rarely witnessed in this month; the moon, which was at the full, and the planet Venus but recently passed her conjunction, presented an assemblage of beautiful objects to the lover of Nature. As soon as the sun had completely set, an Aurora was visible, from the NW. to the NE., of extraordinary brilliancy and variety, presenting a succession of arches, reaching from about 10° above the horizon to within 20° of the zenith, and occasionally completing the arch by uniting at that point; it continued for about three quarters of an hour, and died away gradually at half-past six o'clock. The rest of the night was fine, but more cloudy; on the following day, the 13th, a steady rain began at two o'clock P.M., the barometer having fallen about 2 inch.

AURORA BOREALIS.

IN terminating a communication made to the Petersburgh Academy, regarding the aurora of the 18th of October, 1836, as seen at Dorpat, MM. Struve and W. Preuss deduce the following general conclusions:—"The greyish segment placed near the northern point of the horizon, which seemed to serve as the base of the whole aurora, and which we perceived for a long time at Dorpat, is only the darkened colour of the sky, and not a cloud. We have often observed this segment in very obscure nights and at considerable heights above the horizon, and we have then constantly seen the stars without any sensible diminution of their light. Its obscurity is only the consequence of the contrast which exists between it and the luminous arches which surround it. When the segment is in part divided and illuminated by the luminous arches, we must attribute this effect to the existence of the luminous matter in the parts of the sky which did not previ-

* Philosophical Magazine, No. 72.

ously exhibit any brightness. 2. It appears to us very probable that the distance of the aurora from the observer is not very considerable, at least when the aurora is vividly extended and intense; and that the position of the light is in the clouds. We may even conjecture that the phenomenon of the polar light is partly to be attributed to the constitution of the atmosphere in the region of the clouds. The reflection of the aurora on the whole surface of the ascensional cloud, is explained by the short distance between the earth and the red light that is perceived; for the simultaneous existence of the aurora borealis with the formation of the cloud, proves the great similarity of the white bands and the white veil to those of the same sort which present themselves without any aurora, but which are much less intense; so that, when we perceive the white horizontal bands that have lasted a long time, we believe, first of all, that they are a white cloud formed by the debris of the first aurora borealis. 3. We are of opinion that the explanation of the aurora requires the observation of general terrestrial circumstances as well as of local conditions, especially when the phenomenon is of great extent.*

OBSERVATIONS ON THE METEORS OF THE 12TH OF NOVEMBER.

By Professor Forbes.

A COMMITTEE appointed by the physico-Mathematical Society (University of Edinburgh) were employed on the nights of the 12th and 13th of Nov., in watching for the annual fall of meteors, expected to take place about that time. During the earlier part of the night of the 12th there was a fine coloured Aurora: at 7^h 30^m, a red arch extended from E. to W., passing about 15° South of the zenith, and within 15° of the full moon. This continued with slight variations till 9^h, when it stretched from E. to SW., there being a beautiful red spot at the point of radiation a little S. or SE. of the zenith. The red colour continued with variations till 10^h 15^m, when the whole northern half of the sky was covered with bright greenish streamers. Soon after the sky became covered with clouds and mist, through which the brightest stars only were visible. There was scarcely any wind. Till late in the morning no meteors of any importance were seen. At 9^h 35^m one meteor shot from E. toward N NE., and at 10^h 20^m another from the zenith along the meridian. At 0^h 25^m one passed from, N.NW. to SE., and at 1^h 45^m another shot nearly due S. About 4^h, however, the sky cleared, and between that and 5^h 10^m four bright meteors were seen in the immediate vicinity of Leo, of whch the three last had paths inclined so as to meet in that constellation. All these were inclined towards the north, and more inclined the higher in the sky. Throughout the night of the 13-14th, clouds, mist, and sleet prevailed, and nothing was seen. It may be added, that Professor Nichol, of Glasgow, mentions, that about five o'clock of the morning of the 13th he saw three meteors, at intervals of two seconds, shoot from the centre of Leo towards the south, from which he concludes that a shower did take place at an earlier period of the night.†

* Jameson's Journal, No. 47.

† In the *Comptes Rendus* of the 27th Nov. are some accounts of observations, on the night of the 12th and 13th, at Paris, Montpellier, Geneva, and Marsailles.

THE NOVEMBER ASTEROIDS.

A SHARP look-out appears to have been kept at Plymouth, both at sea and on shore, for the shooting-stars which were expected on the night of the 12th and 13th of November. Several officers of the navy, and Mr. Southwood of Devonport, have enabled a Committee of the Plymouth Institution to transmit a diagram of the meteors observed, accompanied with notes of the time of each phenomenon, its altitude and direction, the character of the light, and incidental remarks.

On November 11, there was noted	1
——— 12, weather hazy	0
——— 13,	25
——— 14,	18
——— 15,	16
Total	60

The directions were,

West	31	South-east	2
South-west	3	South-east by East	1
North-west	1	East	2
North	6	Unknown	9
North-east	1		
South	4	Total	60

The times were :—

Between sunset and midnight	19
Between midnight and sunrise	41
Total	60

The Constellations in which they appeared were :—

Cygnus	1	Cassiopeia	2
Musca Borealis	1	Cepheus	1
Auriga	12	Pegasus	2
Linx	2	Orion	2
Perseus	5	Monoceros	1
Camelopardalus	1	Gemini	3
Triangula	2	Draco	1
Ursa major	1	Cancer	1
Ursa minor	1	Cetus	1
Leo minor	1	Canis major	1
Andromeda	2	Virgo	2*
Taurus	14		

THE NOVEMBER ASTEROIDS.

Notice of a recent Communication relating to them, by Dr. Olbers.

THOSE who take an interest in physical sciences have, within these few years, had their attention directed to the periodical return of shooting-stars; and recent observations go far to subvert the opinions formerly held with respect to them—namely, that they originated within the limits of our atmosphere. On the contrary, it is now looked upon as an established fact, that they are heavenly bodies of inconsiderable dimensions, but which,

* Magazine of Popular Science, No. 15.

in common with all others of a similar nature, have, of course, a regular motion. They are, in short, supposed to represent, in the solar system, the animalcules of the animal kingdom.

Olbers, in the *Jahrbuch fur* 1837, brings forward, with irresistible force and clearness, numerous proofs in favour of this supposition; and the following general sketch will, it is hoped, give a faithful abstract of the arguments to which he therein has recourse, in favour of the new theory.

On the 12th of Nov., 1799, before sun-rise, Humboldt and Bonpland, on the coast of Mexico, observed, during four hours, a succession of many thousand shooting-stars and small fire-balls. The part of the heavens whence they emanated lay due east, and they extended over a space of 30° to the right and left of that point. They rose above the horizon in an east-north-east direction, and fell towards the south, describing unequal arcs in their course. Some attained an altitude of 40°, and there were none that did not rise to between 25° and 30°. Several appeared to burst; the largest, however, disappeared, without throwing out any coruscations. Some had a large nucleus equal to Jupiter in brightness, and all, or nearly so, had tails.

This remarkable phenomenon was also simultaneously observed from various distant points of the earth. A similar display was again witnessed on the night of the 13th of November, 1831; on the night of the 12th of November, 1832; on the same night in 1833; and on the night of the 13th of November, 1834.

This periodical return induced many persons, where the cloudy state of the weather did not altogether put a stop to their observations, to keep a good look out on the nights between the 11th and 14th of November, 1836; nor was the trouble they thus took thrown away, for it appears that a vast number of shooting-stars were actually at that time observed from the most distant points of the globe.

The periodical return of these bodies would thus seem to be established, but this is not sufficient for us to form any just notions as to their nature. The first step to be taken to that end is to discover what their elevation above the earth's surface may be.

In order to arrive at this, two observers in concert determine the angle under which they see a shooting-star, indicating likewise the time of its appearance, and noting the star near which it came into sight. Now, if two such observers remark at the same instant, and in the same direction and position, any shooting-star, it may fairly enough be assumed that they are looking at one and the same object. A triangle is thus obtained; the base, that is to say, the distance between the observers, and the two angles of which, are approximately known, so that the calculation of the distance presents no difficulties whatever.

Simple as these observations are, it is evident that they cannot pretend to any thing like exactness; as they are, however, very numerous, their errors thereby eliminated, and approximate results, at least, are arrived at; and the distance being thus ascertained, their real velocity may be deduced from the apparent.

Olbers conveys his opinions respecting these bodies in the following terms. The remarkable and very unequal distribution of those small bodies revolving round the sun, which form the fire balls and shooting-stars of our planetary system, as well as the general resemblance and nearly similar nature of all the meteoric stones which fall from time to time (taking into consideration both their external characters, and also their chemical composition), seem to indicate, not only that they have one common origin,

but also that it was one common cause, which has thus hurled them into space.

One cannot help reverting, involuntarily, to the hypothesis which holds the four new planets, Vesta, Juno, Pallas, and Ceres, to be but fragments of a larger planet, formerly revolving round the sun between Mars and Jupiter, but which has been shattered to pieces by some violent catastrophe. On such a planet as this exploding, and being scattered about in all directions, there would also be, independent of the larger fragments, innumerably much smaller, indeed minute pieces, hurled into space, and these would now circulate about the sun in ellipses of various degrees of eccentricity.

It must be borne in mind, that Olbers treats this, however, as a mere hypothesis, and distinctly says he by no means adopts the language of Professor Wildt, who, as may be seen by referring to the 9th volume, p. 408, of *Voigt's Magazin fur den neusten Stand der Naturkunde*, unreservedly asserts, the stones which have fallen on the earth to be "the ruins of some globe which has been destroyed, and which revolve round the sun till, sooner or later, they fall in with a planet.

"They, without doubt, he continues, belong to the group of Ceres, Pallas, *&c.*, and thus we see how it is that their appearance and composition bear such general resemblance to each other."

What we really know of shooting-stars, of those at least, which are allied to fire-balls, if not actually identical with them, may be summed up in the following words:—

1st They move at considerable elevations above the earth, their distances from it ranging from between 140 to 190 miles.

2ndly. Their velocity is equal to that of several of the planets; and their relative velocity, compared with the earth, may vary from 37 to 42 miles in a second.*

3dly, Hence it is from without the regions of space that they enter our atmosphere, and it is not within the limits of the latter that they originally take their rise

4thly. They are not ejected into the earth from the moon.

Much that is connected with these interesting meteors, it is, however, quite out of our power to explain For instance, how is it that they become ignited? How is it that, in the extremely rare medium in which they move, they continue glowing, or, indeed, burning with such brilliancy? How can the comparative small mass of the meteoric stones which falls to the earth expand in those elevated regions to bodies several hundred feet in diameter?

Must we not suppose, with the acute Van Hoff, of Gotha, that the materials of which shooting-stars originally consist are submitted to a peculiar chemical process upon entering into our atmosphere, the result of which is the formation of the substance we see fall as meteoric stones,—a process which surely cannot consist merely of fusion?

All these questions, and many others of a similar nature, will possibly remain for ever unanswered, or be, at least, but unsatisfactorily solved; for it scarcely appears probable that time can give us a deeper insight of the circumstances connected with this subject. How can we, indeed, even hope to arrive at a satisfactory knowledge of processes carried on at altitudes where the air is far rarer than in the most perfect vacuum we can pro-

* Littrow gives the mean velocity of Mercury only at 30 miles per second, that of the earth at 19 miles, and the mean of the four new planets at 12.

duce, and where, moreover, the atmosphere possibly consists of gasses of which we know nothing, and all carried on at a temperature of absolute cold. What powers affinity, electricity, and magnetism are there invested with, will always remain a mystery to us.*

OBSERVATIONS MADE ON THE NIGHT OF NOVEMBER 12, 1837.

By Mr. W. H. White, M. B. S., Secretary to the Meteorological Society.

This being the anniversary of the return of those meteoric displays which have occupied the attention of men of science for several years past, I very carefully watched the appearance of the heavens from sunset, which was one of the most brilliant I had witnessed for some time past; and found myself amply repaid, not with witnessing any meteoric display, but one of those singularly electric phenomena that seldom become visible in this latitude, and which, in colour, greatly resembled the rosy-hued band of light that stretched itself across the heavens on February 18, 1836.

The full moon rose majestically, if I may use the expression, and gave that summer-like effect to the evening which is rarely witnessed at so advanced a period in autumn. One of my sons, at half-past five o'clock, called my attention to what he took to be a lunar rainbow: this was a band of reddish-coloured light, stretching across the heavens below Ursa Major, from W. to N. This lasted only a few minutes; and the tinge became, as it were, transferred to some thin and previously transparent clouds, which followed each other from N. to S. in quick and wavelike succession. Bands of white and red clouds rapidly succeeded each other. At six P. M., the western part of the heavens appeared as if reddened by the reflection from some distant conflagration. At a quarter past eight, the red light began gradually to fade away, and to assume a yellowish tinge; the clouds forming themselves into parallel bands, about the magnetic meridian. At nine P. M., no tinge of colour was perceptible; but the white clouds still maintained their parallel positions, till past eleven o'clock, when a beautiful corona formed round the moon, which exhibited the prismatic colours in the greatest perfection I ever witnessed on similar occasions. At half-past eleven, thick clouds collected in the S. E., and soon completely hid the moon from view. The magnetic north appeared like the early dawn of a summer's morning, which, at midnight, was no longer visible, in consequence of clouds. This beautiful phenomenon has amply made amends for the absence of a meteoric display. As there appeared a decided connexion with the magnetic curves, I apprehend this to have been an electrical phenomenon; and, as similar phenomena are frequently witnessed in higher latitudes previously to the occurrence of terrestrial disturbances, as earthquakes, hurricanes, &c., may we not consider this phenomenon to have been in some way connected with the late storms of thunder and lightning, and the furious gales that characterized the commencement of the present month, and which are so unusual at this advanced period of the year?†

SHOOTING STARS.

M. Arago announces that an extraordinary appearance of shooting stars took place in the night of the 10 to the 11th of last August. His eldest son, who is no astronomer, and one of his friends, walking in the

* Magazine of Popular Science, No. 19.

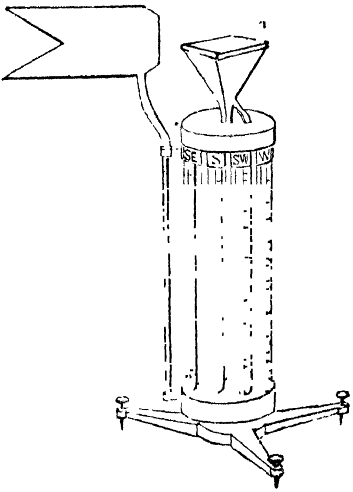
† Magazine of Natural History, No. 12.

garden of the Observatory, counted not less than 107 between a quarter past eleven and a quarter past 12. From $12^h\ 37^m$ to $3^h\ 26^m$ at the beginning of the twilight, MM. Bouvard and Laugier, astronomical students, observed 184 of these meteors. The greater number seemed to take a direction towards Taurus, as was to be expected from the direction of the motion of translation of the earth.—*Comptes Rendus*, August, 1837, p. 184.*

NEW RAIN-GAUGE.

By the Rev. Thomas Knox, M.R.I.A.

On the 26th of June last a new rain-gauge was exhibited to the Royal Irish Academy, contrived by the Rev. Thomas Knox.



The object of this instrument is to register the amount of rain that falls when the wind is in different points. Its construction is very simple. The water,—instead of descending from the reservoir directly into the tube of registry,—passes through a lateral tube into an annular-shaped vessel, divided into eight compartments, each of which terminates below in a graduated glass tube. It is obvious, then, that if the eight tubes be set to correspond with the cardinal and intermediate points, and that the reservoir be made to revolve on a vertical axis by means of a vane, the direction of which corresponds with that of the lateral tube, the object proposed will be attained. Mr. Knox has preferred to make the reservoir fixed, and the system of tubes movable; but the result is obviously the same.†

NEW CONSIDERATIONS IN FUTURE ESTIMATES OF THE HEIGHT OF THE ATMOSPHERE.

All determinations of the height of the atmosphere founded upon the duration of the twilight, which have been admitted up to the present time, repose upon the hypothesis that the solar rays which define the limits of the phenomenon have been reflected but once. All have supposed, that after two reflections by aerial strata, the solar light is so much attenuated as to be no longer appreciable. These elements can no longer be admitted into the calculation. Experiments on the polarization of light have, in

* Philosophical Magazine, No. 73.

† Philosophical Magazine, No. 67, Third Series.

in fact, proved, that reflections, though repeatedly multiplied, still contribute very materially to the dissemination of the sun's light through the atmosphere, and that, in every direction, there are rays, which, after frequent reflection, continue to make a notable part of every pencil of solar light which enters the eye. Further, it will be evident, that by the introduction of this new element into the calculation, the altitudes of the atmosphere will be found to be less than those given by the old method. *

METEOR AT PERNAMBUCO.

On the 11th of December, 1836, at half past 11 at night, a brilliant meteor of great diameter was seen over the vilage of Macao, at the entrance of Reo Assu: it pursued a direction from north to south, and had been seen in Ceara more than sixty leagues off. It burst with a loud explosion almost immediately after its appearance at Macao, and projected an immense number of aërolites over a space more than twenty leagues in diameter: these masses broke through the roofs of many dwellings, and killed or wounded many oxen in the fields; numbers of the stones were found embedded in the sandy plains where none such existed before.†

ESTIMATE OF SOLAR HEAT ANNUALLY RECEIVED BY THE EARTH.

The surface of the globe being four times the area of a section of the sunbeam constantly incident on it, and the quantity of heat continually received by the earth, (or, at least, into its atmosphere), being necessarily greater than the maximum *ever* observable at its surface, it follows from this that the solar heat annually incident on our globe would suffice to melt, *at least*, 84·54 feet of ice over its whole surface. Perhaps 100 feet would be nearer the truth; the radiation here assumed as an example, being by no means the greatest I have observed at the Cape. The clouds, however, probably radiate off a large proportion of this heat as soon as received, and prevent its ever reaching the ground.‡

REMARKABLE SPOTS ON THE SUN IN MARCH, 1837.

The following note was made by Sir John Herschel, at Fieldhausen, near Wynberg, at the Cape of Good Hope, during the Spring-equinox of the present year.

"The sun at present is, and has long been, affected with a display of spots, extraordinary both in point of number and magnitude, and in every point of view extremely remarkable. They do not, however, appear to have affected its emission of heat; at least, I perceive no marked excess or defect of radiation, as indicated by the Actinometer, this year, compared with corresponding seasons of 1834, 1835, and 1836. This instrument puts all such inquiries completely within our power." §

ANEMOMETERS OF MESSRS. WHEWELL AND OSLER.

At the late meeting of the British Association, Mr. Whewell rapidly sketched the principle on which his instrument registered the quantity of

* Magazine of Popular Science, No. 14. † Ibid, No. 22.
‡ Ibid, No. 20. § Ibid.

aërial current passing any place. He had exhibited the instrument in an unfinished state at the Dublin meeting, and in a more matured state of its existence at Bristol; it had since received some valuable improvements, which were suggested by the practical working of the machine. That he might not occupy the time of the Section too long, it would suffice at present to say, that in it a small set of wind-mill vanes, something like the ventilators placed in our windows, were presented to the wind by a common vane, let the direction of the wind blow how it might: the aerial current as it passed set these vanes into rapid motion, and a train of wheels and pinions reduced the motion, which was thence communicated to a pencil traversing vertically, and pressing against an upright cylinder, which formed the support of the instrument, and that 10,000 revolutions of the fly only caused the pencil to descend the one-twentieth of an inch. The surface of the cylinder was japanned white, and the pencil as the vane wavered kept tracing a thick irregular line, like the shadings on the coast of a map: the middle of a line was readily ascertained, and it gave the mean direction of the wind actually exhibited before the eye by a diagram, while the length of the line was proportional to the velocity of the wind, and the length of time during which it blew in each direction; which therefore gave what he called the integral effects of the wind; or the total amount of the aërial current which had passed the place of observation in the direction of each point of the compass during the interval which had elapsed since the time of last recording the instrument. This, it was well known, was a subject of much importance in meteorological speculations, but has not been hitherto accomplished. It was indeed deemed of much consequence, to obtain even the mean direction of the wind at a given place, and the celebrated Kämtz, in his *Meteorologie*, has made a collection of several results of this kind; but, in the ordinary way of registering even the direction of the wind, which is, by stating the length of time it blows from a certain point of the compass, it is obvious the velocity of the wind is altogether left out of account, and therefore the high wind or storm of one day, is placed on a par with the gentle breeze of the next, and therefore not an attempt can be made to infer the total quantity, or what he had ventured to term the integral effect of the wind. Mr Whewell then exhibited large diagrams, giving the results of the observations recorded at the Cambridge observatory, under the care of Professor Challis, and at the house of the Cambridge Philosophical Society. The similarity of the curves showed a general coincidence, but some discrepancies were accounted for by the fact, that the dome of the Equatorial instruments sheltered the anemometers placed at the observatory on the north side, while that placed upon the house of the Philosophical Society was well situated for receiving the wind from every quarter. Anemometers on this principle had been also erected by Professor Forbes and Mr. Rankin, at Edinburgh, and by Mr. Snow Harris and Mr. Southwood, at Plymouth; but he was not at present prepared to state the results of the observations made with them, though he had little doubt they would be interesting and useful.

The President of the Section supposed it would rather suit the convenience of the Section to hear Mr. Osler give the description of his anemometer and rain-gauge, before they proceeded to make observations on the communication of Mr. Whewell: accordingly,—

Mr. Osler, of Birmingham, read an account of a new Registering Anemometer and Rain-gauge, now in use at the Philosophical Institution, at

Birmingham, illustrated by diagrams, giving a condensed view of the observations recorded during the first eight months of the year 1837.

He observed, that although the results obtained by this instrument are essentially different from those produced by the anemometer exhibited last year at Bristol, by Professor Whewell, he should have hesitated to introduce the one now submitted to the Section, had he not been kindly encouraged so to do by that gentleman himself. In this instrument the direction of the wind is obtained by means of the vane attached to the rod, or rather tube that carries it, and consequently causes the latter to move with itself. At the lower extremity of this tube is a small pinion working in a rack, which slides backwards and forwards as the wind moves the vane, and to this rack a pencil is attached, which marks the direction of the wind on a paper ruled with the cardinal points, and so adjusted as to progress at the rate of one inch per hour by means of a clock. The force is at the same time ascertained by a plate one foot square, placed at right angles to the vane, supported by two light bars running on friction rollers, and communicating with a spiral spring in such a way that the plate cannot be affected by the wind's pressure, without constantly acting on this spring, and communicating the quantum of its action by a light wire, passing down the centre of the tube to another pencil below, which thus registers its degree of force. The rain is registered at the same time by its weight acting on a balance, which moves in proportion to the quantity falling, and has also a pencil attached to it recording the result. The receiver is so arranged as to discharge every quarter of an inch that falls, when the pencil again stands at zero.

Mr. Whewell spoke highly of the construction of this anemometer, and he had no doubt but that a very slight modification of the mode of registering its indications would cause it to answer every purpose which he had lately described as desirable. In its present form, however, it was the force of the aerial current which it indicated, not the integral effect. He also highly commended the rain-gauge, and the method of showing to the eye in one diagram so many important meteorological phænomena. Professor Lloyd stated, that there was a very simple method of causing the anemometer of Mr. Osler to give the integral effect of the wind, and that was to cut out the paper covered by the tracings of the pencil indicating the force of the wind, and to weigh it; for it was easy to perceive, that since the ordinates of the curved spaces covered by those tracings were proportional to the force, and, therefore, the velocity of the wind, and the abscissæ to the time, the areas represented the integrals, or the total amount of the aerial current.—Mr. Ettrick asked, whether some other method of supporting the cylinder which moved back and forward as the force of the wind varied, rather than friction rollers, would not be desirable—such, for instance, as bridle rods, or other means known to practical mechanics, and, he was sure, well known to Mr. Osler. Mr. Osler replied, that many methods of supporting this part of the apparatus had been tried and laid aside, as not answering; among the rest, bridle rods.

STORM AT CONSTANTINOPLE.

The following is an extract from a letter from Admiral Roussin to M. Arago, regarding certain periodical storms at Constantinople:—"Last night (the 10th of August) we had a violent storm; it is periodical, and oc-

curs almost every year between the 10th and 15th of August. This storm commenced in the south, and then veered to the north, approaching the Black Sea, its ordinary domain. It lasted from one o'clock in the morning to daybreak with great violence, and accompanied by a furious rain; the lightning struck three points near to one another; at Pera, at the embassy of Denmark, and at that of Spain, it broke the doors, burnt the carpets and curtains, but without touching the panes of glass. The other stroke fell on a small Greek vessel, broke its mast, killed a man, and wounded another. At other times storms are by no means frequent here; I have never seen more than three or four in a year."*

GREAT METEOR.

(NOTE communicated to the Academy by M. Mauvais, pupil at the Observatory.)—"On Thursday, 21st of September, 1837, at 7h. 48′ mean time, as I was crossing the square of the Pantheon, on my way to the Observatory, I suddenly perceived a dazzling ball, which produced so great a light, *that objects threw a distinct shadow*. It commenced its course from a point situated at nearly an equal distance from the eagle and the dolphin; passing θ of the Eagle, it was suddenly extinguished near α Capricorn, a little to the east of that star, leaving behind it a long luminous train. The duration was not above 6″ or 7″; nevertheless, as the light which it diffused made me turn my eyes to the quarter from which it came, it is probable that the meteor had existed for some seconds before I perceived it. Its form was rounded at the lower part (that which, following the movement of the ball, was in front); the upper part was less distinctly terminated. It gave out in all directions brilliant rays of white light. Its diameter, in a horizontal direction, seemed to me equal to a fourth part of that of the moon. The sudden appearance of a light so vivid, in a sky which was quite obscure, (the moon had not then risen,) called forth an exclamation of surprise from all those near me who were witnesses of the phenomenon."†

NEW ANEMOMETER.

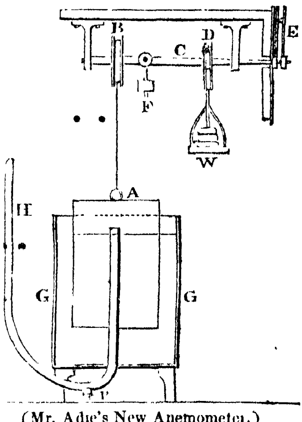
THE Honorary Silver Medal of the Society of Arts for Scotland, 1836, has been awarded to Mr. Adie, optician, of Liverpool, for his construction of a new anemometer, the details of which are as follow:

The instrument consists of a light cylindrical vessel, made of thin copper, close and air-tight at one end, the other being open. This cylinder is placed, inverted, within another of greater diameter, filled with water; one end of a tube is made to pass through the bottom of the outer cylinder, and to terminate above the surface of the water, the other is carried into a free and exposed situation; on the top of this tube is placed a chamber, having a funnel-mouth, movable round the tube, and it is made air-tight by a mercury valve. The opening is kept exposed to the perpendicular action of the wind by means of a vane placed opposite and attached to it. Over the end of the tube which passes through the water, the inner cylinder is suspended by a cord passing over a wheel, placed on an axis above, its open end passing into the water. If now a current of air be allowed to pass down the tube, its effect will be to force up the cylinder out of the water, and the measurement of the force with which it acts is ac-

* Jameson's Journal, No. 47. † Ibid.

complished in the following manner:—To the axis having the wheel on it, over which the cord suspending the cylinder passes, is fixed a spiral of variable diameter, in the form of the fuse of a watch; from this spiral is suspended a weight which, when acting on the largest radius, counterbalances the weight of the cylinder suspended in the water when no compression of air is allowed to exist within it; this point is marked zero on the scale or dial-plate, placed at one end of the axis. The dial-plate is divided into parts, showing the force with which the wind is pressing up the cylinder. The scale is formed from actual experiment, by applying weights to the cord passing over the variable lever, the area of the top of the cylinder being accurately known. Any length of scale may be given to the instrument, by making the change in the radii of the spiral increase more or less rapidly, and it may be made to mark the force of the lightest air or of the most violent gale.

The instrument is also made to register the maximum and minimum force in the absence of the observer. This is done by means of two light pointers, attached to the centre of the dial plate, and requiring a very small force to move them: one is placed on each side of the pointer attached to the axes, and by it pushed both ways, the one to the greatest, the other to the least pressure that has occurred.—In the cut, A is the inner cylinder, suspended by a cord passing over the wheel B. C is the axis on which the wheel B is fixed D the spiral fixed on the same axis over which the weight W passes, counterbalancing the cylinder A. E is the index marking the forces on the dial-plate. F counterpoise weights to balance the index and spiral. G the outer cylinder filled with water, into which the cylinder A passes. H the pipe through which the current of air passes into the cylinder A. P a plug to let off any water that may get into the curve of the tube.



(Mr. Adie's New Anemometer.)

The Committee of the Society on Mr. R. Adie's Anemometer report that this instrument is admirably calculated for exhibiting minute variations in the elasticity of gaseous bodies; and that it is more properly to be regarded as a pressure gauge than as an anemometer, the application to the measurement of the pressure of the wind being only one of the numerous uses to which it may be applied. In the gas-works it would be a much more delicate indicator of the progress of the operations than the pressure gauge usually employed there.

In its general construction it resembles that of the floating gas-holder; but it differs from it in this particular, that the elasticity of the air in the gas-holder is kept as nearly as possible the same, whatever quantity may be inside; while in Mr. Adie's instrument, the load is regularly increased with the elevation of the instrument, so that that elevation becomes a measure of the excess of the elasticity of the included air over that of the atmosphere, or of the difference of level between the outer and inner fluid.*

* Jameson's Journal, No. 44.

ST. ELMO'S FIRE IN ORKNEY.

Extract of a Letter from William Traill, Esq., Kirkwall, to Professor Traill, dated May 16, 1837.

During last February, 1837, (Sunday 19,) in a tremendous gale, my large boat sunk, and it was late on Tuesday night before we could get her up and drawn to the shore, after which we had to wait till three o'clock next morning till the tide ebbed from her; she was during this time attached to the shore by an iron chain, about thirty fathoms long, which did not touch the water, when, to my astonishment, I beheld a sheet of blood-red flame, extending along the shore for about thirty fathoms broad and one hundred fathoms long, commencing at the chain and stretching along the shore and sea in the direction of the shore, which was E SE., the wind being N.NW. at the time. The flame remained about ten seconds, and occurred four times in about two minutes. Whilst I was wondering not a little, the boatmen, who, to the number of twenty-five or thirty, were sheltering themselves from the weather, came running down apparently alarmed, and asked me if I had ever seen any thing like this before. I was about to reply, when I observed their eyes directed upwards, and found they were attracted by a most splendid appearance at the boat. The whole mast was illuminated, and from the iron spike at the summit, a flame of one foot long was pointed to the N.NW., from which a thunder-cloud was rapidly coming. The cloud approached, which was accompanied by thunder and hail; the flame increased and followed the course of the cloud till it was immediately above, when it arrived at the length of nearly three feet, after which it rapidly diminished, still pointing to the cloud, as it was borne rapidly on to S.SE. The whole lasted about four minutes, and had a most splendid appearance. I regreted afterwards that I was so occupied with the flame at the mast-head, that I did not observe whether the red flame on the ground continued during the time the cloud was passing.*

RIPPLE MARKS. MACKEREL-SKY. MOTTLED SOLAR SURFACE.

The small waves raised on the surface of the water, by the passage of a slight breeze are called ripple; and a series of marks, very similar in appearance, which are sometimes seen at low water, on the flat part of a sea-beach formed of fine sand, are called ripple-marks. Such marks occur in various strata; and are regarded as evidence of their having been formed beneath the sea. Similar appearances occur when a strong wind drives over the face of a sandy plain.

It appears that two fluids of different specific gravity, the lighter passing over the surface of the former, always concur in the formation of ripple. It seems also, that the lines of ripple-mark are at rignt angles to the direction of the current which forms them.

If a fluid like air pass over the surface of perfectly quiescent water, in a plane absolutely parallel, it will have no effect; but if it impinge on the surface of that water with the slightest inclination, it will raise a small wave, which will be propagated by undulations to great distances. If the direction of the wind is very nearly parallel to the surface of the

* Jameson's Journal; quoted in the Magazine of Popular Science, No. 19.

water, this first wave, being raised above the general surface, will protect that part of the water immediately beyond it from the full effect of the wind, which will therefore again impinge upon the water at a little distance; and this concurring with the undulation, will tend to produce another small wave, and thus again, new waves will be produced. But the under surface of the air itself will also assume the form of waves; and so, on the slightest deviation at any one point from absolute parallelism in the two fluids, their whole surfaces will become covered with ripples.

If one of the fluids be water, and the lower fluid be fine sand, partially supported in water, these marks do not disappear when the cause ceases to act, as they do when formed by air on the surface of water. These are the marks we observe when the tide has receded from a flat sandy shore.

If, after the formation of ripple-marks at the bottom of a shallow sea, some adjacent river, or some current, deposit upon them the mud which it holds in suspension, then the former marks will be preserved, and new ripple-marks may appear above them. Such is the origin of those marks we observe in various sand-stones, from the most recent down to those of the coal-measures.

Dr. Fitton informs me, that he found the sand-hills on the south of Etaples, (in France,) consisting of ripple-marks on a large scale. They are crescent-shaped hillocks, many of which are more than a hundred feet high. The height is greatest in the middle of the crescents, declining towards the points; and the slope on the inner side of the crescent, which is remote from the prevailing direction of the winds, is much more rapid than that on which it strikes.

Mr. Lyell has observed and described this mode of formation of ripple on the dunes of sand near Calais; remarking, that in that case there is an actual lateral transfer—the grains of sand being carried by the wind up the less inclined slope of the ripple, and falling over the steep scarp. I have observed the same fact at Swansea.

A similar explanation seems to present itself as the origin of that form of clouds familiarly known as "a mackerel sky"—a wave-like appearance, which probably arises from the passage of a current of air above or below a thin stratum of clouds. The air being of nearly the same specific gravity as that of the cloud it acts upon, would produce ripples of larger size than would otherwise occur.

The surface of the sun presents to very good telescopes a certain mottled appearance, which is not exactly ripple, and which it is difficult to convey by description. It may, however, be suggested, that wherever such appearances occur, whether in planetary or in stellar bodies, or in the minuter precincts of the dye-house and the engine-boiler, they indicate the fitness of an inquiry, whether there are not two currents of fluid or semi-fluid matter, one moving with a different velocity over the other, the direction of the motion being at right angles to the lines of waves.*

* Mr. Babbage, in Jameson's Journal; quoted in the Magazine of Popular Science, No. 19.

METEOROLOGICAL SUMMARY OF 1837.*

MONTHS.	TEMPERATURE. Fahrenheit Max.	Fahrenheit Mean	Mean. Reaumur.	Mean. Centigrade	Mean. De Lisle.	ATMOSPHERIC VARIATIONS. Mean Pressure in Inches	Prevailing Currents.	HYGROMETER. Lowest.	Mean.	Quantity of Rain in Inches.	MODIFICATIONS OF CLOUD. Cirrus.	Cirro-stratus.	Cumulus.	Cirro-cumulus.	Cumulo-Stratus.	Nimbus.	Stratus.
JANUARY	53	35	9·5	12	132	29·75	SW. NE.	9·5	34·4	2·314		+			.		
FEBRUARY	57	42	4·5	5·5	141	29·62	E. SW. NW.	19	34	1·580	.	+	.		+	.	
MARCH	53	38	3·75	3·5	144·5	29·65	NE. NW.	20	38·5	0·434	.	+	+	+	.	.	
APRIL	66	46	6·00	7·5	139	29·65	W. SW. NE.	26·5	48	0·895		+	.	.	.	.	
MAY	78	56	11·	14·5	130	30·10	SW. NE.	28	45·5	1·672	.	+	+	.	.	.	
JUNE	87	64	14·75	18	123	30·10	NW. SW. NE	35·5	50	0·891	.	+	+	.	.		
JULY	84	64	14·75	18	123	29·37	NE. SW.	41	54·5	1·433		+	+	.		.	.
AUGUST	80	61	13·00	16·5	125	29·91	SW. N.E.	46	55·5	3·600		+		.	.	.	
SEPTEMBER	75	56	11·00	13·5	130	29·81	NW. S.W. NE	36·5	53	0·892		+		.	.	.	.
OCTOBER	73	51	8·5	11·00	134	30·09	SW. W.	32	44	1·819		+			.	.	
NOVEMBER	56	39	3·5	14·00	144	29·76	W. SW.	25·5	40·5	1·418	.	+		.	.	.	
DECEMBER	58	43	5·00	6·00	140·5	30·25	NE. W. SW	14·5	37·5	·980	.	+		.		.	

Number of Days for the greater part rainy .. 21	Number of Days fair throughout, but cloudy .. 266
Number of Days for the greater part fair .. 54	Number of Days clear and cloudless 25

The degrees of temperature are ascertained from a self-registering thermometer, and the Means from a comparative scale, both graduated by Ronketti, Museum Street: altitude, 28 feet, facing north, aspect east.

The averages of atmospheric pressure result from observations taken on a traversing barometer, by the same maker.

The highest winds were on Feb 11, 13; June 7, 8; Sept. 14, 22, 23, 24; Dec. 19, 20;—violent gale, Nov. 1.

The Highest Tides, Jan. 20; Feb. 27, March 6, 7.

The greatest atmospheric pressure for many years back, on Oct. 13, 14, being 30·94.

Immense spot on the Sun's disc, on Feb 25, 26, visible to the naked eye.

Thunder and lightning on May 14, June 5, 18; July 16, 30; Aug. 26, 30; Sept. 1.—Brilliant fire-ball, Aug. 23.

Dense fog on Jan. 14, Nov. 8, 9;—unusually dense, Dec. 2, 4.

Slight snow on Jan. 29; snow on the ground from March 20 to 26; April 10; Dec. 9.

In the Tabular Section, under Modifications of Cloud, the crosses indicate the prevailing cloud of the month; and the dots denote the cloud of least frequent occurrence.

* Communicated by Dr. Lambel, Retreat, South Lambel

RURAL ECONOMY.

Mr. Heathcoat's Steam-Plough.—By the aid of the Prize Essays and Transactions of the Highland and Agricultural Society of Scotland in the 37th Number of the *Quarterly Journal of Agriculture,* we are enabled to submit to our readers the following illustrated details of this interesting invention :—

"Mr. Heathcoat obtained a patent for his plough in 1832. The particular use to which he has, in the first instance, applied to it, is the reclamation of *Bogs or Mosses,* which, of all descriptions of soils, offer perhaps the greatest natural obstacles to improvement by mechanical means.

"Mr. Heathcoat's machine appears to have effectually overcome all these obstacles. Such at least is the result of the experiments hitherto made with it. A very important trial took place on the 20th of April last, on a bog or moss in Lancashire, called the *Red Moss,* near Bolton-le-Moors, in presence of a deputation of the Highland and Agricultural Society of Scotland, which was attended with complete success. Meanwhile, some description may be given of the machine, and its mode of operation, founded chiefly upon the information supplied at the time of the experiment to the secretary, by Mr Parkes, the very intelligent practical engineer employed by Mr. Heathcoat in its construction and management.

"The machinery employed to act upon the plough is of too complex a nature to admit of very detailed figures in this place; but in order to convey some idea of its general appearance, the accompanying cuts are given, from which a notion of the form and arrangement of its principal parts may be conceived.

"The second cut is to be considered as a plan of a field partly ploughed, in which the different parts of the apparatus are represented in their relative positions, though not in their true proportions. S is the principal machine, P P the ploughs, and *x x* the auxiliary carriages. The double lines D D, extending from S to *x*, and passing through P, being flat iron bands, afterwards described, by which the plough is drawn.

"The folding cut is a sketch in perspective,* done chiefly from recollection, of the principal machine, including the steam-engine, occupying the left side of the cut, and of the plough, which is seen to the right.

"The apparatus, it will be seen, embraces three distinct parts; 1st, The steam-engine and machinery connected with it, forming of itself a complete locomotive system.

"2nd The auxiliary carriage placed, when circumstances will permit at the distance of 220 yards on either side of the principal machine.

* In order to prevent confusion in this figure, the arms in the outer wheels only of the drums are represented, and the greater part of the gearing is also left out.

"And 3rd, The plough, which traverses between the other two. In situations sufficiently extensive to admit of a reach of furrow on both sides of the principal machine, an auxiliary and plough are employed on each side, as denoted by their positions in the opposite cut.

"This cut, exhibits a very imperfect outline of the principal machine, the parts seen being chiefly those that form the medium of locomotion. They consist of two pairs of skeleton drums, one placed at each end of the apparatus. These pairs of drums are about 26 feet apart: they are formed individually by the combination of three wheels of equal diameter, placed parallel to each other, and connected by a common axle; they are nine or ten feet in diameter. These four drums stand towards each other somewhat in the relation of the four wheels of a large wagon. The two drums on each side of the machine, being one of each pair, are embraced by a great, endless band of about 7½ feet in breadth, formed of planks laid transversely, and held in connexion by several flexible iron-hoops applied to the interior surface of the planks, and to these lines of hoop the planks are individually fixed by bolts, thus forming bands sufficiently flexible to apply round the periphery of the drums.

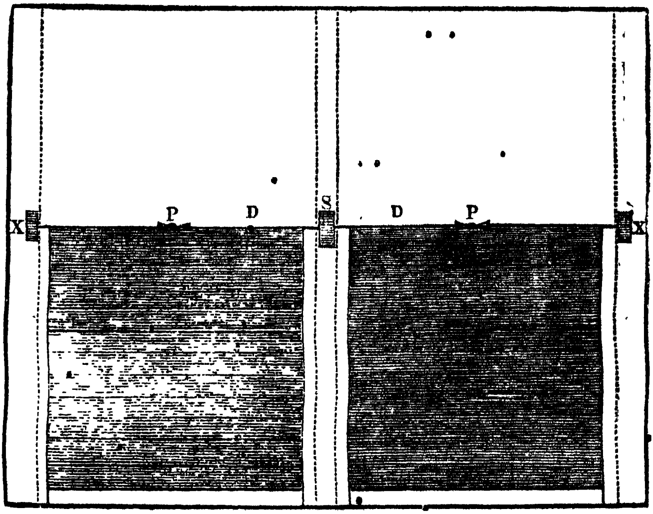
"In this cut, A B points out the drums, and F F the bands, leaving an open space between their inward edges of six or seven feet all round the apparatus, so that the distance between the extreme edges of the two bands extends to about twenty-one feet. To keep the drums at the proper distance, and so prevent the collapsing of the bands, their axles are supported in the extremities of a strong framework or platform, which again is supported through the medium of numerous small wheels or friction rollers upon the lower part of the great bands. These wheels are arranged in rows so placed as to fall upon the lines of hoop while at the same time they turn upon axles fixed to the platform, and thus afford an easy, smooth motion to the platform, even when loaded with all its machinery.

"To complete this system of locomotion, the steam engine E, with all its machinery, is placed on the platform already alluded to; the engine is constructed on the same principles as those employed on railways, differing only in the speed given to the medium through which its locomotion is conveyed. In the present case the motion is reduced by a combination of gearing branching off to each side of the engine, and ending in a large spur-wheel fixed on the axle of each of the drums situate towards the left of the figure in the second cut. Another branch of gearing is led off to each side of the engine, to give motion to the pulleys on which the band that draws the plough is spirally coiled.

"2nd, The auxiliary part of the machinery is a carriage, not seen in the cut, but represented by *x x* in the plan, one being placed on each side of the field, mounted on four wheels, and furnished with the requisite gearing, by which a man can move it forward. It is also furnished with a large, plain pulley placed horizontally, round which the flat iron band passes, proceeding from, and returning to, the principal machine, whence it derives its motion through the second branch of gearing already alluded to, and to this band the plough is attached. Each of the auxiliaries in its progressive state moves upon two lines of planks; the one line is laid into a shallow trench cut in the moss, the other is simply laid on the surface; the former being for the purpose of resisting the draft of the plough. Three lengths of plank in each line are all that are necessary, the one behind being brought up and laid in before the others in regular succession, as the work proceeds.

"3rd, The plough has but a distant resemblance to that in common

use: it is double, that is to say, has two sets of stilts, one set at each end, and each set consists of four handles, it being occasionally found necessary to employ two men to guide the plough. It has also two shares, coulters, and mould boards, together with all the peculiar apparatus applied to this plough: but it may be said to have no beam. The mould-boards are both on one side, set tail to tail, so that the plough acts to and from the machine without turning round. This plough is most ingeniously constructed for performing the various functions required of it. By means of friction rollers placed under each end, and which give motion to a crank, (simply by the contact of the rollers with the ground), two sets of apparatus are put in motion that perform essential offices in the operation of ploughing moss. These are, first, a peculiar action given to a sharp-edged and crooked blade which is made to traverse against the sharp steeled edge of the coulter, producing the operation of *clipping*, which effectually severs all the roots of the heath, carices, and other strong-rooted plants that occur in the line of the cut made by the coulter. Secondly, a similar operation is simultaneously performed, and by the same impulse, with another set of similar instruments acting under and against the edge of what forms the *share* of the plough; these last separate all the fibrous roots that occur in the sole of the furrow. The form of the mould-boards is such as to turn the furrow slice completely over, and lay it neatly with the heath surface downwards.



(Plan of a Field partly Ploughed.)

"The auxiliary carriages move on lines parallel to the roadway of the principal machine, one being placed on each side, as at *x x*, in the above cut, and at the proposed distance of 220 yards from the machine. The bands D, each of 660 yards in length, pass out from each side of the principal machine, where the ends are secured to one of the machine pulleys on the respective sides, extend to and pass round the large pulley of the

auxiliary, and return again to the machine. At this point the plough is affixed to the band, while as much more of the band is coiled round the other machine pulley respectively, as is equal in length to the distance between the machine and the auxiliaries. The steam-engine being now set on, and the second branch of gearing adjusted to act upon the pulley to which the first end of the band is attached, this pulley will coil up the band, causing the plough to advance towards the auxiliary, and at the same time the other pulley, which at this time is free to uncoil, will deliver off its portion of the band. When the plough has reached the auxiliary, the motion is stopt, the plough is set to the next furrow, the action of the steam-engine on the pulleys is changed by shifting a clutch from the one to the other, and the pulleys reverse their duty, that which was uncoiling now becoming the coiler, and so on, alternately.

"Having thus attempted to give some idea of the construction of the machine, a few observations may be added in reference to the mode of working and the economy of its management. On this subject Mr. Heathcoat's printed description supplies the following quotations:—

"'The machine and auxiliaries remain stationary during the time occupied by the ploughs in taking one furrow; they are then severally put in motion, and made to advance in three parallel lines, in order to keep pace with the breadth of land turned over, and to pull the ploughs accurately straight. The machine is impelled by the engines, and each auxiliary by its attendant man, who also shifts his planks onward as occasion requires. The machine and its auxiliaries have thus to be moved over a space of eighteen inches only, whilst the ploughs have each travelled 220 yards, and turned over 220 square yards of land nine inches in depth; in other words, the machine and auxiliaries have only to be moved eleven yards, in the time that the ploughs have travelled five and a half miles, and turned over a statute acre of land. The ploughs perform their work at the rate of two miles an hour, and are subject to very few stoppages; so that eight acres and three quarters nearly of bog would be ploughed up in a day's work of twelve hours—or, taking the average of daylight throughout the year, and making a liberal allowance for hinderances from weather and other causes, one machine would plough up 2,000 acres in a twelvemonth.'

"*The principal machine, together with a 6-ton load of fuel, weighs about thirty tons, its superficial bearing on the moss is 390 square feet,* giving a pressure of 178 lb. on each square foot. Taking the weight of a man at 168 lb., and the area of his foot at thirty square inches, he would, in walking, press with a weight at the rate of 806 lb. per square foot, so that the machine has a buoyancy of about 4¾ times that of a man, and could therefore travel on much softer soil than red moss, which is considered very wet and spongy.

"The steam-engine of the machine consists of two cylinders, each of ten inches diameter, with a two-feet stroke, and the other appurtenances of a non-condensing engine, together with a fly-wheel, and at a regular speed make sixty strokes per minute. The machine is capable of travelling one inch for every stroke of the engine, or five per minute. This velocity is acquired with a pressure of *steam equal to four pounds on the inch. The drain on either side of the roadway supplies abundance of* water for the boiler.

"The flat iron band by which the plough is dragged is 2⅛ inches broad, and 1-16th inch in thickness.

"The friction of the band, together with the empty plough at the dis-

tance of 304 yards, is overcome with a pressure of steam equal to 8 lb. on the inch, and, when the plough has hold of the furrow-slice, a pressure of 13 lb. is required, making in all 17 lb. pressure of steam on the piston of the engine, which, after deduction of 2 lb. for the friction arising from the piston itself, leaves a total effective pressure equal to fifteen horses' power. This force is required to work one plough moving at the rate of two miles per hour, turning over a furrow-slice of eighteen inches in breadth, by nine inches in depth. If two ploughs were employed, the force would require to be increased to a pressure of 25 lb. on the inch, equivalent to 25 horses' power, and the plough would turn over a surface of 8¾ imperial acres in twelve hours.

"The plough weighs 12½ cwt., is thirty feet in length between the two extremities of the stilts, ten feet in the length of the sole, which last has a bearing surface of ten superficial feet, and leaves an open furrow of two feet in width.

"The consumption of coal required to perform the above operation, is from one and a half to two tons, according to quality, per day. The number of men required would be as follows:—Two to conduct a plough, one to attend the movement of the auxiliary machine, and one to prepare the end of the furrow next to the machine for the entrance of the plough in the succeeding *bout*. The full complement of men, therefore, for two ploughs or sets of harrows, &c., would be eight labourers, one engineman, and one boy to assist in the machine.

"It is quite possible that this description may not be strictly accurate, and it is presented merely for the purpose of enabling the public to form a general idea of the nature of the machine, and its mode of operation. There can be little doubt, that to Mr. Heathcoat must be awarded the palm of having invented a steam-engine which is applicable to the cultivation of the soil, though to what extent remains yet to be determined."

GARDENING.

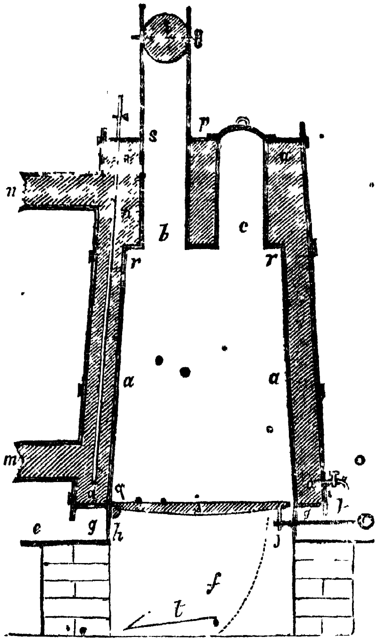
New Mode of grafting the Vine. By Wm. Gowans, Cadder Gardens, near Glasgow.—"I select a scion with one eye (*a*), and cut it into the form of a wedge. For a stock, I select a shoot of the preceding year, about the same thickness as the scion (or stocks of several years I have found attended with equal success), and cut it over a little above the second eye from the old wood (*b*). With a sharp knife I cut it down the centre nearly to the old wood. Out of each half of the stock, but chiefly out of that half which is opposite to the eye, or bud (*b*), I pare, with a penknife, as much as is necessary to make it fit the cuttings on the sides of the scion. I insert the scion with its eye (*a*) opposite to that left on the top of the stock (*b*). I tie it up, and clay it over in the usual manner; with this difference, that I cover nearly the whole of the scion with the clay, leaving only a small hole for its eye. I tie a little moss over the clay, upon which I sprinkle a little water occasionally, to keep the whole in a moist state for some time."

"What seems of essential importance in this mode, is the eye, or young shoot (*b*), left on the top of the stock, which I allow to grow for ten or fourteen days, and then cut it off; leaving only one eye and one leaf to draw sap to the scion, till it be fairly united to the stock.

"As to the time for grafting, I find that it will succeed very well when the stocks are about to break into leaf; but I think there is more certainty of success when the shoots of the stock into which the graft is to be inserted have made four or five eyes of new wood. By this time the sap has begun to flow freely, and there is no danger of the stock suffering from bleeding: but, indeed, if vines are in good health, and thoroughly ripened, there is no danger of bleeding at any time."—*Gardener's Magazine*, No. 84.

The Truffle.—The *Gardener's Magazine*, No. 90, is almost exclusively occupied with a valuable paper on Instructions for Truffle-searching, and another on the Cultivation of Truffles. The first is translated from the German of V. F. Fischer, by Francis Mascall, Esq. of Eppleton, Durham. The second, translated by the same gentleman, is from the German of Alexander Von Bornholz. Both papers are valuable contributions to horticultural knowledge. The translator notes:—Truffles are found in England, if my information be correct, in Sussex, at or near Goodwood, a seat of the Duke of Richmond; and in Northwood, a wood of about a thousand acres, belonging to Lady Newburg, and situate near the parishes of Slindon and Irtham; also in Kent, at Broome, the seat of Sir Henry Oxendon. In the county of Durham, they are met with, if I mistake not, in Castle-Eden-dean, and are to be found in many other parts of England. Truffles grown in England may be bought, both fresh and dried, in Covent-Garden Market in London, where the fresh ones have this year (1833) been sold at the rate of 10*s*. [this year, 1837, they were 14*s*., see Market List, p. 384,] per pound.—Mr. Loudon observes: It has frequently been suggested to us, that the cultivatian of the Truffle would form a very fit subject for premiums to be offered by the principal Horticultural Societies. Could the Truffle, indeed, be subjected to cultivation as effectually as the mushroom, it would be one of the grandest triumphs of horticultural skill; and it would contribute towards rendering of general use an article of luxury which is now enjoyed but by few, and which would prove an additional source of industry and profit to the market-gardener.

Hogg's Patent Conical Boiler.—This boiler, for heating hot-houses and other buildings by hot water, has been invented by James Hogg, of New York, who is but eighteen years of age. The boiler is intended for burning anthracite coal, (which is now most generally used in the United States,) or coke. Anthracite coal gives out a most intense heat, but it is not diffusive enough in a flue, as it has no smoke, and very little flame; and, consequently, owing to the severity of the American winters, great quantities of it are used, which causes much wear and tear of the furnaces, which generally want repairing every season, and resetting at least every two years. To obviate this expense, and to do away with the trouble of attending flues, Mr. Hogg has invented the boiler above described. Its principal merit is, that there is very little loss of heat, nearly all of it being absorbed by the water which passes round the pipes and furnace. The outside, being of strong oak staves, is much cheaper than iron, and nearly as durable; and there is no leakage, warping, or danger from fire, as the furnace is raised, by means of the ring, at least two inches above the iron plate.



The Cut shows a section of the boiler, which consists of a conical iron furnace *a a*, with the two pipes *b* and *c*, and the flanges *d d*, cast in one piece, to which the outside boiler, made of wooden staves, is fitted, and well bound with iron hoops. The whole stands on a square iron plate (*e e*), supported by the brickwork of the ashpit (*f*); and, from the top of this plate, the ring *g g* rises and fits into a bead on the bottom of the furnace. In this ring there are two pins; the one is shown at *h* on which the grate turns, and at *j* there is a hole through which the other pin (*k*) passes, and supports the grate.

The fuel is put in at the top of the pipe *c*, and receives air from the front of the ashpit, which has a register door; the draught passing up the pipe *b*, in which there is a damper (*l*). The two water-pipes (*m m*) are fastened on either by bolts or screws, and they can be made to lead from the boiler either horizontally, or perpendicularly; *n* is an expansion feeding-pipe with a stop-cock; *o* is a stop-cock for drawing off the water from the boiler when it is not in use; *p* is a lid which fits on to the fuel pipe (*c*.) The dimensions are as follows:—The height of the furnace from *g* to *r* is 18 in. The height of the pipes *c* and *d*, from *r* to *s*, is 9 in. The diameter of the pipes *c* and *d* is 4 in. The diameter of the furnace, at the bottom, is 14 in.; and at the top 12 in. The upper flange is 5 in. wider; and the lower flange is 2 in. wider. The staves are 2 ft. 6 in. high.

There is very little heat lost in the pipes *b* and *c*, for the water absorbs it so fast, that a person may hold his hand on them without feeling the least inconvenience. The boiler can be used hermetically sealed, by closing the pipe *n*; but this should not be done unless the outside is extra-hooped.

When the fire is put out, the ashes are removed by pulling out the pin *k*, when the grate falls down and empties itself into the ashpit. The grate is easily replaced by opening the door, raising it up, and replacing the pin. The poker used for this description of fuel is of the form shown at *t* in the Cut; and it is employed for raking the fire through the bars underneath, as anthracite coal goes out if stirred in the usual way.

Since the month of September, 1835, Mr. Hogg has erected nine or ten of these boilers in New York and its neighbourhood, and they give general satisfaction. The price of the boiler is 35 dollars, or 8*l*.

Reid's New Hydraulic Engine, (cut, to a scale of 1¼ in. to 1 ft.)—Our readers are aware of the important improvement made by Mr. Reid in the garden syringe, in 1819, by the introduction of the ball-valve, almost the only description of valve of which it may be said that it never goes out of repair; and that it will continue to act perfectly for a lifetime, or till the materials of which it is composed decay. Mr. Reid has recently made a great additional improvement in this syringe, by which it is, in effect, turned into a garden engine; the difference between a common syringe and an engine being, that the latter forces out the water in one continuous stream. Mr. Reid's improvement consists in an arrangement by which a volume of air is compressed to an indefinite extent, by the working of the piston for forcing out the water, and without any sensible increase of labour to the operator. The manner in which this is effected will be understood by the diagram fig. 2; in which *a* is the piston and cylinder, as in the common syringe; *b*, a case in which this syringe, and also the discharge-tube (*c*), are enclosed; *d*, a small hole in the side of the discharge-tube; and *e*, a valve at the bottom of the discharge-tube: *f* is a valve to the suction-tube, by which the water is drawn up from a watering-pot, pail, or any other vessel. On the motion of drawing up the piston (*a*), the water enters by *f*; while, by pushing down the piston, the valve at *f* is closed, and the water is forced up the valve at *e*, into the discharge-tube; but, as some more water is forced into this tube than can pass through it, it escapes, by the small opening at *d*, into the vessel of air in which the working barrel and the discharge-tube are encased. As the air cannot escape from this vessel, it is necessarily compressed by the water which enters through the small opening at *d*; and, consequently, when the piston (*a*) is drawn up, and no longer forces the water up the discharge tube (*c*), the action on that tube is kept up by the expansion of the compressed air which shuts the valve at *e*, and, consequently, forces the water along *c*.

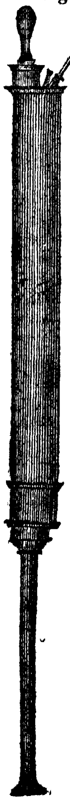


fig. 1.

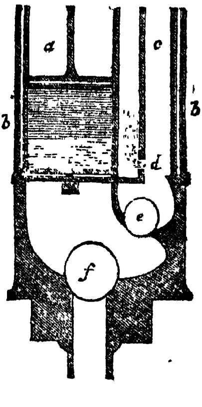


fig. 2.

A great beauty in this arrangement is, that no exertion of the operator is lost; nor can he exert himself without producing a corresponding result; for if, by rapid and powerful action, he drives much water into the air-vessel, the greater degree in which the air is compressed will force the water with the more rapidity through the discharge-tube (*c*). In this way, it may be said that the superfluous exertion

of the operator is not only saved, but turned to powerful account in producing a continuous stream. Mr. Reid states that this saving of labour is one third as compared with other engines of the kind.

Fig. 1 shows a general view of the engine, to a scale of 1½ in. to 1 ft.: by which it appears to be 3 ft. in length; and the outer casing is 2¼ in. in diameter. It weighs between 5 lb. and 6 lb.; it works with remarkable ease, and is warranted by Mr. Reid to last a lifetime. By the addition of a flexible tube of 4 ft. in length, it becomes an excellent veterinary syringe, and, as such, will be nearly as useful to a farmer as to a gardener. Like Mr Reid's common syringe, it is also valuable for aiding in the extinction of fires newly broken out.

USEFUL ARTS.

Joyce's new Mode of Heating.—Mr. Joyce, a commercial gardener at Camberwell, has recently made one of the most extraordinary inventions for producing heat which has ever been given to the public. We question if any thing so remarkable has occurred, in a practical point of view, since the *invention* of gunpowder. Whether Mr. Joyce's stove will be so economical as to be adapted for general use, is a question that can only be satisfactorily determined by experience; but in the mean time it promises to be so; and, while it may be employed to heat churches, and all kinds of public and private buildings, ships, and the inside of carriages, Mr. Joyce thinks that the poorest cottager will find more comfort and economy in its use than in the common open fireplace. The invention not being, at the time we write, fully secured by patent, the details cannot be here given; but the result is, that heat is produced by an apparatus of very limited magnitude, and that it may be raised to any temperature that can be required, short of red heat, by combustion without the production of smoke. To most of our readers this will seem impossible; but the fact was placed beyond a doubt on Dec. 5, when one of Mr. Joyce's stoves, in action, was exhibited at a meeting of the Horticultural Society in Regent Street, and examined by a great number of persons. The form of the stove in which the heat is generated is that of an upright cylinder, from the conical apex of which a heated current of air escapes, and which current can be regulated at pleasure, or altogether stopped: but the chief source of heat is the radiation from the sides. Of course, the heat so generated may either be allowed to escape directly into the surrounding atmosphere, or be conveyed away in air-tubes, or by means of hot-water pipes, to a distance, or to any other apartment. If this invention answer the expectations which have been formed of it, it will effect a complete revolution in the mode of heating dwelling-houses throughout the world: because it is the only mode hitherto discovered by which heat can be produced by combustion, without any heat being lost. At present, whether a room is heated by an open fireplace, a close stove, steam-pipes, or hot-water pipes, or by the introduction of a current of heated air from a cockle-stove, still a large proportion of heat neces-

sarily escapes along with the smoke produced by the consumption of the fuel; but here not one particle of heat escapes, and the only care requisite in regard to the air of a room will be, to have a quantity of fresh air admitted proportionate to what is deteriorated by the combustion of the material employed in this new mode of heating, and by the persons breathing in the room. One advantage attending this invention is, that it is perfectly free from dust, and that the stove, when once charged and lighted, requires no attention whatever for from twenty to thirty hours, according to the charge. The convenience of such a mode of applying heat to rooms without fireplaces, closets of every description, cabinets, whether of books, curiosities, or plants, &c., and, in short, to all inclosed places without chimneys, must be obvious. It is also adapted, beyond all other inventions, for heating, with security from fire, ships, and for warming the inside of close carriages; and it might be taken under water in a diving bell, or into the atmosphere in a balloon.

Since the preceding article appeared in the *Gardener's Magazine*, the inventor, Mr Joyce, has taken out a patent "for an improved apparatus for heating churches, warehouses, shops, factories, hot-houses, carriages, and other places requiring artificial heat, and improved fuel to be used therewith. Sealed December 16." The specification to be given in within six months. (*Repert. of Patent Inventions*, Jan., 1838, p 62.) A partnership has been formed between Mr. Joyce and Mr. Harper, and the stove has been exhibited privately to some friends and scientific men at the Jerusalem Coffee-house, Cornhill. Scarcely any thing was said respecting this mode of heating in the daily, weekly, or monthly journals, (except the *Gardener's Magazine*,) that we are aware of, till January 13; when the *Mechanics' Magazine* and the *Literary Gazette* contained each a short article on the subject, of which the following is the essence:—

Joyce's new stove "is in the form of a tall urn, having a pipe running entirely through the centre, with a cap, or valve, at the top, to regulate the draught. The urn is of thin bronze, about 2 ft. high, and 8 in. in diameter. By the combustion of the fuel inside, the metal continues at a dull red heat, and so gives off the caloric to the surrounding air. The fuel is stated to be a vegetable substance, and one charge in a stove of the above-described dimensions will burn for 30 hours, and will cost sixpence. No smoke or effluvia are produced." (*Mech. Mag.* Jan. 13, 1838.)

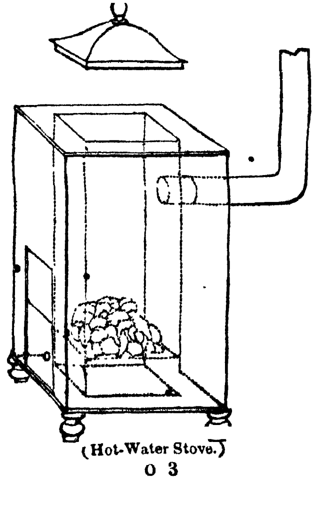
"*The New Mode of Heating Rooms*, &c.—The puzzle which has been shown at the Jerusalem Coffee-House has set the wits of conjecturers at work upon the nature of the particular fuel which, at so cheap a cost as one farthing an hour, is to warm a room. Of these conjectures we have heard two: the first is, that the gardener who discovered the fuel, which enabled him to keep up the fire whilst he slept, must have used old tanner's bark, as it was the only fuel accessible in a hot-house; the other is, that charcoal is the base, and lime employed to absorb the carbonic acid gas. Gipsies are in the habit of using the ashes of their fires, raked together in a heap, and sprinkled with lime. This will burn throughout the night, and give out much heat, and no deteriorating gas is evolved to distress the sleepers in the gipsy tent."—*Lit Gaz.* Jan. 13, 1838.

These instruments are made of different sizes, according to the purposes they are intended for. One will, at the expense of only 3*d.* per 12 hours, maintain a room of 1,300 cubic feet, at the temperature of 60° or 70° Fahr.; one for a carriage, would cost only 1*d.* for 15 hours. The fuel of it, it is said, need only be put in once in 24 hours, or even once a week, and will require no subsequent attention.

Dr. Arnott's Thermometer-Stove.—The Treatise "*on Warming and Ventilating*," wherein the construction of the Thermometer-Stove is described, contains the substance of a Lecture delivered before a scientific audience at the Royal Institution, in 1836. The reason for not publishing it sooner was the author's anxiety to perfect his information by experiments under great variety of circumstances, and at all seasons of the year; added to his general anxiety to render the treatise as complete as possible. Proceeding to the details of the Stove, we pass over several pages, containing a sketch of the chief means of warming which were known and practised up to the year 1834. The Doctor, setting before him the problem, "to secure effectually, in any part of the world, and at all seasons, the temperature, moisture, and purity of atmosphere most congenial to the human constitution,"—resumes his study as follows:—

"That I might have constant motive and better opportunity to observe, to experiment, and to reflect on the subject, I directed a manufacturer to fit up in my library, the apparatus for warming by circulating hot water. Accordingly, a box of iron to hold water was placed at one side of the room, having communication by ascending and descending pipes, with a boiler fixed at the back of the kitchen fire, and so that as soon as the fire was lighted, circulation of the water might commence, and be continued at nearly boiling heat while the fire burned. This apparatus effected, in weather not very cold, (for it was of too small dimensions for the room,) all the pleasing results described in a former page, as belonging to the warm-water circulation—mild, equal temperature over the room, no dust, smoke, trouble of watching a fire, danger of fire, draughts, cold layer of air on the floor, &c. The objections were, 1st, That in very cold winter nights, when the kitchen fire was not burning, the safety and supply pipes which descended from an external cistern, were exposed to freeze. On one occasion, the water in the safety-pipe did freeze, and, by shutting in the steam, endangered my safety when the fire was next lighted. 2ndly, Considerable expense of fuel. 3rdly, Considerable original expense of apparatus. 4thly, That when once fixed it could not be moved to another place. 5thly, The noise and disturbance (likely to distress a sick person,) of the regiment of bricklayers, plumbers, smiths, and carpenters, who came under a master and foreman to set it.

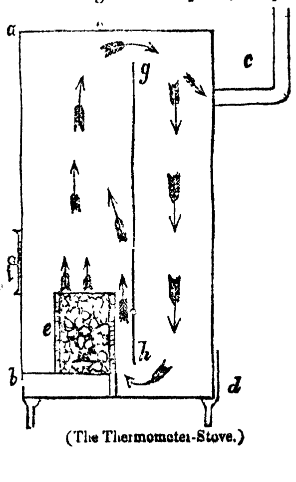
A mode of obviating several of the objections without much countervailing trouble, at once occurred to me, and was tried; namely, to have the box of water heated, not by communication with a distant fire, but by a small fire within itself, as here represented. This constituted a water-clad stove, and as the steam of the water, when heated to the boiling point, passed by an aperture provided, into the chimney, the external surface of the box could never be hotter than



(Hot-Water Stove.)

boiling-water, and could no more, therefore, vitiate the air of the room than the simple water-box did. To prevent the water from boiling too rapidly, and being wasted, the air, to feed the combustion, was admitted only by a small aperture near the door of a close ashpit, in which aperture was placed a throttle-valve, regulated by a peculiar thermometer which will be described in a future page. The aperture was closed by the thermometer whenever the temperature reached the boiling point, or any other point that might be chosen, and was opened again whenever the thermometer fell to below the point chosen. This stove, besides its uniform moderate temperature—for it was a box of boiling water which, although giving out heat, never cooled—had nearly all the economical advantages of the close German or Dutch stove, for so much of the chimney-flue might be exposed in the room as to apply usefully nearly all the heat of the smoke. There was here, however, still an apparatus, rather difficult to make, and expensive, liable to be out of order, heavy, requiring considerable attention from servants, &c. It may be mentioned, however, that several forms of the water-clad stove may still be useful.

After the step made, by the construction of the stove just described, it was easy to make another and more important step. The object sought was now clearly seen to be, merely to place in any apartment the required extent of metallic surface, kept steadily at a temperature not exceeding 200° of Fahrenheit. It evidently was of no importance what hot fluid filled and warmed the vessel—whether water, steam, oil, or air, or whether there were an included fire—provided the temperature of the surface was maintained; for the box in any case would be quite close, permitting no escape of its contents. If, therefore, in a box of the required size, a fire could be placed so as to warm the box with perfect uniformity all around, while the fire itself were so controlled by a self-acting regulator, that it should burn always exactly as fast as was required to keep the box steadily at any desired temperature, the object sought would be attained, and there would be many concomitant advantages of cheapness, simplicity, &c. These words have sketched the *Self-regulating Fire*, or *Thermometer-Stove*, of which the form first tried is to be described more particularly by aid of the Cut.



(The Thermometer-Stove.)

The outline *a b d c* represents a box formed of sheet-iron, and divided by the partition *g h* into two chambers, communicating freely at the top and bottom. The letter *e* marks the fire-box or furnace, formed of iron, lined with fire-brick, and resting on a close ash-pit, of which *b* marks the door, and near which door there is a valved opening, by which air enters, to feed the fire when the door is shut; *i* marks the door of the stove, by which fuel is introduced—*c* is the chimney-flue. While the stove-door and ash pit door are open, a fire may be lighted, and will burn

in the fire-box just as in a common grate, and the smoke will rise and pass away by the chimney, mixed with much colder air, rushing in by the stove-door; but if the stove-door and ash-pit door be then closed, and only as much air is admitted by the valved opening in the ash-pit as will just feed the combustion, only a small corresponding quantity of air can pass away by the chimney, and the whole box will soon be full of the hot air or smoke from the fire circulating in it, and rendering it every where of as uniform temperature as if it were full of hot water. This circulation takes place, because the air in the front chamber around the fire-box, and which receives as a mixture the red hot air issuing from the fire, is hotter, and therefore specifically lighter, than the air in the posterior chamber, which receives no direct heat, but is always losing heat from its sides and back; and thus, as long as the fire is burning, there must be circulation. The whole mass of air is, in fact, seen to revolve, as marked by the arrows, with great rapidity; so that a person looking towards the bottom of the stove through the stove-door *i*, might suppose, if smoking fuel had been used to make the motion visible, that he was looking in at the top of a great chimney. The quantity of new air rising from within the fuel, and the like quantity escaping by the flue *c*, are very small, compared with the revolving mass. There remains to be noticed only the thermometer regulator of the combustion. Many forms presented themselves to my mind, as described in the section on the manufacture of the stove, any one of which will close the air-passage, slackening or suspending the combustion at any desired degree, and will open it again instantly, when the temperature falls below that degree.

I had thus a simple box of iron, of cheap and easy construction, answering all the purposes of expensive steam or hot-water apparatus, burning its fuel as steadily and regularly as an argand lamp burns its oil, or as an hour-glass lets its sand run through, and allowing me, by merely touching a screw on the thermometer, rapidly to increase or diminish its heat, as by touching another regulating screw we increase or diminish the light of a lamp.

What chiefly surprises a stranger in this new stove, is the very small quantity of air required to support the combustion which warms a large room; the whole might enter by an opening of half an inch diameter, and the quantity of air or smoke which passes into the chimney is of course proportionally small. These facts at once suggest how small the consumption of fuel must be, as that depends on the quantity of air entering, how perfect the combustion of the fuel must be where so little is expended, and how completely the heat produced in the combustion must be turned to account. The combustion is so perfect, because the fuel is surrounded by thick fire-brick, which confines the heat so as to maintain intense ignition; and the saving of heat is proved by the rapidly diminishing temperature of the flue, detected by a hand, passed along it from the stove. During the winter 1836-7, which was very long and severe, my library was warmed by the thermometer-stove alone. The fire was never extinguished, except for experiment or to allow the removal of pieces of stone which had been in the coal, and this might have been prevented by making the grate with a movable, or shifting bar. The temperature was uniformly from 60° to 63°. I might have made it as much lower or higher as I liked. The quantity of coal used, (Welsh stone coal,) was, for several of the colder months, six pounds a day—less than a penny-worth—or at the rate of half a ton in the six winter months. This was a

smaller expense than of the wood needed to light an ordinary fire, therefore the saving was equal to the whole amount of the coal-merchant's ordinary bill. The grate, or fire-box, fully charged, held a supply for twenty-six hours. It might have been made twice as large, or to hold a supply for two days, and there would have been no waste, as the consumption is only proportioned to the air allowed to enter; but, in general, it may be convenient to have to look at and charge the fire in the middle of the day and at bed-time. Many strangers coming into my room did not suspect that I had fire in the stove, for it was used generally as a table for a book-stand. They thought the agreeable warmth of the room came from the kitchen, or some neighbouring room. I believe that persons must themselves feel, to be able truly to conceive, the charm, in dreary winter, of knowing, wherever they be, in cold, or rain, or snow, that a perfect and unvarying summer room always awaits their return home.

The thermometer-stove, as compared with other modes of warming, will be best understood by reviewing its chief qualities. A general expression for them is, that it possesses all the advantages of steam or hot-water warming, with many advantages peculiar to itself.

Dr. Arnott then specifies these advantages further in detail than we can follow. In proof of *economy of fuel*; instead of wasting ⅞ of the heat, as in a common open fire, the Thermometer Stove saves or puts to use nearly the whole heat, "because first it does not allow the air which had fed the combustion to escape until deprived of nearly all the heat; and secondly, it does not allow any of the warm air of the room, except the little which feeds the fire, to escape through the chimney. A sheet of paper set fire to, and put into a cold stove, will warm the whole almost as if boiling water had been poured into it, and the same heat is afterwards diffused in the room. The same sheet of paper burned under the chimney of an ordinary grate would produce no sensible effect in the room. The expenditure of the stove is *an eighth of the fuel needed for a common fire;* and stone-coal, or anthracite, coke, and even cinders—in a word the cheapest fuel—answers better than that which is dearer. Next is *uniform temperature in all parts of the room,* and throughout the day; while the stove being always a light, the temperature of the room does not become cold in the night. *No smoke,* or rather invisible gas, can come from the stove into the room; there is no *dust,* as in poking a common fire, for when the ashes are taken away, the dust set in motion in the close ash-pit naturally passes through the fire, and up the chimney. There is no danger of *falling into the fire;* if the chimney be of moderate size, the box cannot possibly be made dangerously hot: in short there is no danger, as from common fires. In this stove, fire is "a good servant," without being a master; for the heat may be increased or diminished by the screw of the regulator, as simply as the light is varied by the screw of a lamp. The *saving of fuel* in one winter will nearly pay for a stove. It may be moved, after the chimneys are prepared, nearly as a large chair or a chest of drawers.

It is a good cooking-stove, and therefore the poor man's stove.—A second small iron box placed within it, with a door opening outwards through the side of the stove, is a perfect oven—as is proved, indeed, by the common American stove, which in this respect resembles it. A small kettle or cooking vessel may be placed directly on the fire. Potatoes and other articles of food may easily be roasted in the ash-pit; and if the ash-pit be made large, with the fire-bars sloping, so as to present a considerable surface of naked fire looking downward and forward, meat may be roasted there.

MISCELLANIES.

LIST OF ENGLISH PATENTS SEALED IN 1837.

(*For.*) denotes communicated by a foreigner residing abroad.

Staining Glass.—W. Cooper, Picardy Place, Edinburgh, glass merchant and stained glass manufacturer, for an improved method of staining glass.—Jan. 10, 1837.

Screws.—R. Griffiths, Smethwich, Warwick, machine maker, and S. Evers, Cradley Iron Works, Stafford, iron-manufacturer, for improvements in the manufacture of burs or nuts for screws.—Jan. 11.

Furnaces.—H. Adcock, Birmingham, Warwick, engineer, for improvements in furnaces for the reduction of ores, and in some of the processes of the iron manufacture of other metals.—Jan. 11.

Turnip-Cutter.—J. Gardner, Banbury, Oxford, ironmonger, for improvements in cutting turnips.—Jan. 11.

Soda.—C. Sheridan, Ironmonger-lane, London, chemist, for improvements in the manufacture of soda.—Jan. 11.

Prussiates.—J. P. Neumann, Great Tower-street, in the city of London, for improvements in the manufacture of prussiate of potash and prussiate of soda, (*for.*)—Jan. 11.

Distilling.—G. Goodlet, Leith, Edinburgh, merchant, for a new and improved mode of distilling from wash and other articles; also applicable to rectifying, boiling, and evaporating or concentrating.—Jan. 11.

Soda.—F. G. Spilsbury, Newman street, Middlesex, engineer, and W. Maugham, of Newport-street, Lambeth, Surrey, chemist, for improvements in the manufacture of carbonate of soda.—Jan. 11.

Road-Making.—J. Macneill, Parliament-street, Middlesex, civil engineer, for improvements in making or mending turnpike roads.—Jan. 11.

Carriages.—J. Braby, Duke-street, St. Mary, Lambeth, Surrey, wheelwright and coach maker, for improvements in the construction of carriages.—Jan. 11.

White Lead.—R. Sewell, Carrington, Basford, Nottingham, lace manufacturer, for improvements in the manufacture of white lead.—Jan. 11.

Glass-Making.—C. T. Coathupe, Wraxall, Somerset, glass manufacturer, for improvements in the manufacture of glass.—Jan. 11.

Fire-Arms.—J. Gall, Aberdeen, Scotland, carpenter and builder, for an improved mode of priming fire-arms applicable to percussion locks.—Jan. 17.

Silica.—A. Dunn, No. 22, Nelson-street, City-road, Middlesex, manufacturing chemist, for an improved mode of dissolving silicious matter and compounds of silica, and of manufacturing soap.—Jan. 17.

Oil Paints.—W. Gossage, Stoke Prior, Worcester, chemist, for improvements in manufacturing oxide of lead, for paints, and to other purposes; also in bleaching and purifying oils, and fatty matters.—Jan. 19.

Carriages.—J. Murray, Fitzroy-square, Middlesex, gentleman, for improvements in the construction of carriages.—Jan. 19.

Fire Arms.—M. Poole, Lincoln's Inn, Middlesex, gentleman, for improvements in ordnance and other fire-arms, (*for*)—Jan. 19.

Snuffers—H. N. Scrope Shrapnel, Bayswater-terrace, Middlesex, Esq., for improvements in snuffers.—Jan. 19.

Vessels.—W. S. Gillett, Guilford-street, Middlesex, gentleman, for improvements in trimming and facilitating the progress of vessels in water.—Jan. 21.

Sugar Refining.—J. Oliver, Castle-street, Falcon-square, London, gentleman, for improvement in the filters employed in sugar refining.—(*for.*), Jan. 24.

Woollen Manufacture.—J. Cuttell, Hollingfoith, near Huddersfield, York, woollen manufacture, for improvements in producing slubbings and in spinning wool, (*for.*)—Jan. 26.

Screws.—M. Berry, Chancery-lane, Middlesex, patent agent, for improvements in machinery for manufacturing metal screws, also applicable to shaping metal for other purposes; (*for.*)—Jan. 28.

Dyeing.—J. Hellewell, Springfield-lane, Salford, Lancaster, dyer; and A. Fearn, Salford, dyer, for improvements in the machinery for dyeing and scouring piece goods and other fabrics.—Jan. 28.

Horse Shoes.—J. Springall, Oulton, Suffolk, iron founder, for improved shoes for horses and other animals.—Jan. 31.

Gas-lighting—J. Cook, Birmingham, Warwick, gun-maker, for improvements in gas-burners.—Feb 2.

Steam-engines—W. Geeves, Old Cavendish-street, Middlesex, gentleman, for improvements in steam-engines.—Feb. 2.

Peat—M. Linning, Hill-street, Edinburgh, Clerk to the Signet, for an improved method of converting peat moss and peat turf, or bog, into fuel, and obtaining from it tar gas, &c.—Feb. 6.

Steam-vessels.—J. Gemmell, Stockwell-street, Glasgow, Lanark, merchant, for improvements in steam-vessels.—Feb. 6.

Steam-engines.—W. Bearder, Bradford, York, millwright, for improvements in steam-engines.—Feb. 16.

Heating—J. Walker, Allen-street, Lambeth, Surrey, oven-builder, for an improved method of heating coppers, stills, and boilers.—Feb. 16.

Harness.—W. S. Gillett, Guildford-street, Middlesex, gentleman, for improvements in harness for draught and saddle horses.—Feb. 16.

Steam-engines.—R. Burch, Heywood, Lancaster, mechanist, for improvements in locomotive steam-engines, upon rail or other roads; also applicable to marine and stationary steam-engines.—Feb. 16.

Boilers.—R. Smith, Manchester, Lancaster, engineer, for improvements in connecting metallic plates for boilers.—Feb. 16.

Steam—J. I. Hawkins, Hampstead-road, Middlesex, civil engineer, for improvements in the application of the products of combustion in generating steam, (*for.*)—Feb. 16.

Coating Metals.—H. Elkington, Birmingham, Warwick, gentleman, for improvements in apparatus for coating metals with platina, gilding, &c.—Feb. 17.

Steam-boilers.—H. Elkington, Birmingham, Warwick, gentleman, for improvements in boilers, and furnaces, of steam-engines.—Feb. 17.

Furnaces.—J. Chanter, Earl-street, Blackfriars, London, Esq., and J. Gray, of Liverpool, Lancaster, engineer, for improvements in furnaces for locomotive engines.—Feb. 17.

Ventilation.—B. Baillie, Cumberland Market, Regent's Park, Mid-

dlesex, metal frame maker, for improvements in regulating the ventilation of buildings.—Feb. 20.

Steam-engines.—J. Hardman, Bradford, York, millwright, for improvements in steam-engines.—Feb. 21.

Carriages.—J. Weston, Dover, Kent, gentleman, for improvements in wheeled carriages.—Feb. 23.

Brandy.—J. T. Betts, Smithfield Bars, London, rectifier, for improvements in making brandy, (*for.*)—Feb. 25.

Woollen Manufacture.—T. Bentley, Clockheaton, near Leeds, York, dyer, for improvements in fulling woollen cloths.—Feb. 25.

Rotation.—J. Robinson, North Shields, Northumberland, engineer, for a nipping lever for the rotation of wheels, shafts, or cylinders.—Feb. 28.

Protective Paper.—D. Stevenson, Bath Place, New Road, Middlesex, gentleman, for a new method of preparing writing paper, from which writing ink cannot be expunged without detection, (*partly for.*)—Mar. 2.

Parallel Motion.—T. B. Whitfield, New-street-square, Middlesex, lamp manufacturer, for improvements in producing parallel motion to the piston-rods of pumps for lamps and other purposes.—Mar. 4.

Pumps.—S. Stocker, Bristol, gentleman, for improvements in pumps.—Mar. 4.

Protective Paper.—C. F. E. Aulas, Grande Rue Verte, Paris, gentleman, now of Cockspur-street, Middlesex, for improvements in preparing writing-paper so as to prevent the discharge of the ink therefrom without detection.—March 6.

Block-Printing.—H. Backhouse, Walmsley, Bury, calico printer, and J. Grime, Bury, Lancaster, engraver, for improvements in the art of block-printing.—March 7.

Wool-Spinning.—J. Shaw, Rishworth, Halifax, York, book-keeper, for improved machinery in preparing wool.—March 7.

Cotton-Spinning.—J. Chesnutt, Manchester, Lancaster, mechanist, for improvements in the machinery for spinning, doubling, and twisting cotton, &c..—March 8.

Lamps.—C. W. Celarier, St. Paul's Chain, London, Esq,. for improvements on lamps, (*for.*)—March 10.

Steam-boats.—N. Snodgrass, Glasgow, Lanark, engineer, for improvements in steam-boats.—March 15.

Metallic Pens.—H. C. Windle, Walsall, Stafford, merchant, J. Gillot, Birmingham, Warwick, metallic pen manufacturer, and S. Morris, of Birmingham aforesaid, artisan, for improvements in pens.—March 15.

Cutting Wood.—C. F. E. Aulas, No. 38, Grande Rue Verte, Paris, gentleman, now of Cockspur-street, Middlesex, for a new and improved method of cutting and working wood by machinery, (*for.*)—March 15.

Paving.—R. Macnamara, Hunter-street, Southwark, gentleman, for improvements in paving streets and roads.—March 15.

Mechanical Power.—H. Davis, Stoke Prior, Worcester, engineer, for improved machinery for obtaining mechanical power and for impelling or raising fluids.—March 15.

White Lead.—W. Maugham, Newport-street, Lambeth, Surrey, chemist, for improvements in the manufacture of white lead.—March 15.

Woollen Cloths.—J. Walton, Sowerby Bridge Mills, Warley, Halifax, York, woollen manufacturer, for improvements in machinery for manufacturing and finishing woollen cloths.—March 21.

Fermented Liquors.—M. Poole, Lincoln's Inn, gentleman, for improvements in making fermented liquors, (*for.*)—March 21.

Cleaning Coffee.—R. Nelson, Liverpool, Lancaster, gentleman, for a machine for cleaning coffee.—March 21.

Hemp.—M. Berry, Chancery-lane, Middlesex, mechanical draftsman, for improvements in machinery for heckling and roving hemp, flax, tow, &c., (*for.*)—March 27.

Working Metals.—J. Haley, Manchester, Lancaster, machine maker, for improvements in machinery, for cutting, planing, and turning metals.—March 28.

Working Metals.—J. Whitworth, Manchester, Lancaster, engineer, for improvements in machinery, for turning, boring, planing, and cutting metals.—March 28.

Inkstands and Pens.—H. Stephens, Stamford-street, Blackfriars-road, Surrey, writing fluid manufacturer, for improvements in inkstands and pens for writing.—March 28.

Steam Navigation.—M. B. Lauras, Lyons, now residing in Leicester-square, Middlesex, merchant, for improvements in steam navigation.—April 4.

Furnaces.—H. Booth, Liverpool, Lancaster, Esq., for improvements in locomotive engine-boilers and other furnaces.—April 4.

Evaporation.—W. Wynn, Dean-street, Soho, Middlesex, clock maker, for improvements in diminishing the evaporation of, and for preventing the absorption of, noxious effluvia in wines, spirits, malt liquors, cider, perry, and vinegar.—April 4.

Distorted Limbs.—J. Amesbury, Burton Crescent, Middlesex, surgeon, for apparatus for the relief of stiffness, weakness, or distortion in the limbs.—April 4.

Woollen Cloths.—W. Weekes, King Stanley, Gloucester, clothier, for improvements in the dressing or finishing woollen cloths.—April 4.

Weaving.—J. L. Roberts, Manchester, Lancaster, merchant, for improvements in looms for weaving, (*for.*)—April 11.

Chimneys.—R. Bull, Adam-street West, Portman-square, Middlesex, ironmonger, for improvements in chimney-caps.—April 15.

Spinning.—H. N. Aldrich, Rhode Island, United States of America, now of Cornhill, London, merchant, for improvements in spinning, twisting, doubling cotton, silk, &c., (*for.*)—April 15.

Dyeing.—H. Stephens, Charlotte-street, St Marylebone, Middlesex, gentleman, and E. Nash, of Buross-street, St. George in the East, Middlesex, tallow chandler, for improvements in dyeing.—April 18.

Letter-press Printing.—D. Napier, York-road, Lambeth, Surrey, engineer, for improvements in letter-press printing.—April 18.

Bobbin-net.—*W. Crofts, New Radford, Nottingham,* machine maker, for improvements in bobbin-net.—April 18.

Caoutchouc.—T. Hancock, Goswell-road, Middlesex, waterproof cloth manufacturer, for improvements in rendering cloth impervious to air and water by caoutchouc.—April 18.

Drying Machinery.—E. Haworth, the younger, Bolton, Lancaster, gentleman, for improvements in machinery for drying fabrics; for the further term of five years.—April 18.

Fermenting Grain.—C. Farina, Maida Vale, Middlesex, gentleman, for an improved process in obtaining fermentable matter from grain.—April 18.

Bleaching.—L. W. Wright, Manchester, Lancaster, engineer, for improvements in machinery for bleaching.—April 20.

Bleaching.—W. Gratrix, Salford, Lancaster, silk-dyer, for improvements in the process of bleaching, &c.—April 22.

Chronometers.—J. G. Ulrich, Red Lion-street, Whitechapel, Middlesex, chronometer maker, for improvements in chronometers.—April 22.

Propelling Carriages.—Sir G. Cayley, baronet, Brompton, York, for improvements in propelling carriages on common roads or railways.—April 25.

Railway Propulsion.—J. Pim, jun., College Green, Dublin, banker, and T. F. Bergin, Westland-row, Dublin, civil engineer, for an improved means of propulsion on railways.—April 25.

Brick Machinery.—M. Berry, Chancery-lane, Middlesex, patent-agent, for improvements in machinery for making bricks, tiles, &c., (*for.*)—April 27.

Horse-shoes.—M. Berry, as aforesaid, for improvements in machinery for making horse-shoes, (*for.*)—April 27.

Preventing Rust.—H. W. Crawford, No. 5, John-street, Berkeley-square, Middlesex, R.N for an improvement in coating iron and copper, for the prevention of oxydation, (*for.*)—April 29.

Dyeing.—A. Dixon, and J. Dixon, Clockheaton, Leeds, York, manufacturing chemists, for improvements in dyeing.—April 29.

Umbrellas.—J. Barker, Regent-street, Lambeth, Surrey, artist, for improvements in umbrellas and parasols.—April 29.

Gas-lighting.—J. B. Mollerat, No. 27, Leicester-square, Middlesex, manufacturing chemist, for improvements in gas for illumination.—May 2.

Lace.—J. Heathcoat, Tiverton, Devon, lace-manufacturer, for machinery for manufacturing ornamented work, gauze, muslin, net, &c.—May 4.

Buttons.—T. W. Ingram, Birmingham, Warwick, horn button manufacturer, for improvements in buttons, (*for.*)—May 4.

Heating and Evaporating.—T. Baylis, Tamworth, Stafford, civil engineer, for improvements in heating and evaporating fluids, (*for.*)—May 6.

Wool Combing.—H. Ross, Leicester, worsted manufacturer, for improvements in combing of wool and goat hair.—May 6.

Carriages.—G. Hayman, Exeter, coach builder, for improvements in two-wheel carriages.—May 6.

Sculpture.—A. Robertson, Peterborough-court, Fleet-street, London, gentleman, for new or improved machinery for sculpturing marble, stone, alabaster, &c., for taking copies of works, and casts of the human face, (*for.*)—May 6.

Sulphate of Soda.—T. Bell, South Shields, Durham, chemist, for improvements in the manufacture of sulphate of soda.—May 8.

Reels.—W. Nairne, flax spinner, Millhaugh, Perth, for improvements in reels, (*for.*)—May 8.

Zinc Roofs.—P. Steinkeller, London Zinc Works, Shoreditch, Middlesex, gentleman, for plates or tiles of zinc, (*for.*)—May 8.

Propelling Vessels.—G. Spurgin, Guildford-street, Russell-square, Middlesex, M.D., for improvements in propelling vessels through water.—May 8.

Carriage Wheels.—J. Hague, Castle-street, Wellclose-square, Middlesex, engineer, for improvements in wheels for carriages.—May 10.

Propelling Carriages.—J. Boydell, jun , near Howarden, Flint, Esq., for improvements in propelling carriages.—May 11.

Heating and Evaporating.—W. Bell, Edinburgh, Esq., for improvements in heating and evaporating fluids.—May 11.

Raising Vessels.—E. Austin, Warwick-place, Bedford-row, Middlesex, for improvements in raising sunken vessels and other bodies.—May 12.

Rail-roads.—P. B. G. Debac, Brixton, Surrey, civil engineer, for improvements applicable to rail-roads.—May 13.

Carding.—W. Rhodes, gentleman, and R. Hemingway, mechanic, both of Earl's Heaton, near Dewsbury, York, for improvements in machinery for carding wool. -May 22.

Isinglass.—G. Nelson, Leamington Priors, Warwick, gentleman, for improved isinglass.—May 22.

Combing.—S. and W. Smith, Luddenden-Foot, near Halifax, York, worsted-spinners, for improvements in combing machinery.—May 23.

Windows.—E. Leak, Hanley, Stafford, engineer and lathe maker, for improvements in shutters and sashes for windows.—May 23.

Explosion of Boilers.—C. P. Devaux, Fenchurch-street, London, merchant, for apparatus for preventing the explosion of boilers, (*for.*)—May 23.

Cables.—Baron H. De Bode, Edgware-road, Middlesex, for improvements in chain or other cables.—May 23.

Rolling Iron.—C. J. Freeman, Frederick's-place, Kennington-lane, Surrey, gentleman, for improvements in rolling iron.—May 25.

Dressing Grain.—J. P. Blake, Little Queen-street, St. Giles, Middlesex, engraver, for improvements in machinery for preparing rough rice and other grain, (*for.*)—May 30.

Power.—J. Woollams, Wells, Somerset, gentleman, for improved means of obtaining power and motion.—May 30.

Closing Doors, &c.—F. W. Gerish, East-road, City-road, Middlesex, smith and ironmonger, for improvements in closing doors, gates, and shutters —May 30.

Tooth Drawing.—R. O. Millet, Penpoll's Hayle, Cornwall, gentleman, for improvements in instruments for extracting teeth.—June 1.

Artificial Mineral Waters.—E. S. Swaine, Leeds, York, for producing and preserving artificial mineral waters, for the further term of seven years.—June 6.

Stone Masonry.—J. C. Daniell, Limpley Stoke, Wilts, gentleman, for improvements in stone masonry.—June 6.

Motive Power.—M. Berry, Chancery-lane, Middlesex, mechanical draftsman, for improvements in obtaining motive power for propelling or working machinery, (*for.*)—June 6.

Gas Retorts.—J. Kirkham, Aldenham Terrace, St. Pancras-road, Middlesex, engineer, for removing the carbonaceous incrustation from the internal surface of gas retorts.—June 8.

Spinning.—J. G. Bodmer, Bolton-le-Moors, Lancaster, civil engineer, for improvements in machinery for spinning cotton, &c.—June 12.

Plate-Printing. -G. Woone, Berkeley-street, Piccadilly, Middlesex, gentleman, for an improved method of forming raised plates for printing. —June 12.

Electric Signals.—W. F. Cooke, Breed's Place, Hastings, Sussex, Esq. and C. Wheatstone, Conduit-street, Middlesex, Esq., for improve-

ments in signals and alarums by electric currents transmitted through metallic circuits.—June 12.

Brick Machinery.—R. Roe, Everton, near Bawtry, York, gentleman, for improvements in machinery for making bricks, tiles, &c.—June 17.

Steam-engines.—J. L. C. Thomas, Covent Garden, Middlesex, Esq., for an improvement in steam-engines and steam-generators, (*for.*)—June 17.

Spinning.—W. Nicholson, Manchester, Lancaster, engineer, for improvements in spinning machinery, (*for*)—June 17.

Mechanical Agents.—J. Buckingham, Great Randolph-street, Camden Town, Middlesex, civil engineer, for improved mechanical agents, in place of toothed gear and other mechanism.—June 17.

Metal and Wood Letters.—T. J. Nash, John-street, Hampstead, Middlesex, letter maker, and J. Ross, Wyld-street, Lincoln's Inn Fields, Middlesex, brass worker, for manufacturing metal and wood letters, figures, and other devices having a flat surface, presenting by the aid of colours the appearance of projections.—June 19.

Caulking Vessels.—W. Yetts, Yarmouth, Norfolk, merchant, for an improved mode of caulking vessels.—June 19.

Hat-Making.—H. A. Wells, late of New York, now of Threadneedle-street, London, hat manufacturer, for improvements in the manufacture of hats.—June 30.

Water Closets.—F. Roe, Camberwell, Surrey, plumber, for an improvement in water-closets.—July 7.

Directing Currents.—J. J. Waterstone, Mill Bank-street, Westminster, Middlesex, surveyor, for improvements applicable to the directing of currents and waves of water.—July 10.

Capstans.—W. P. Green, Falmouth, Cornwall, lieut., R. N., for improvements in capstans and machinery employed in raising, lowering, and moving bodies.—July 10.

Night Commodes.—W. Chubb, Portsea, Hants, umbrella manufacturer, for improvements in night commode pans.—July 10.

Wire Manufacture.—T. North, Mitre-street, New Cut, Surrey, card paper, and metal piercer, for an improvement in the manufacture of wire.—July 19.

Docking Horses.—W. Baker, Dedham, Essex, veterinary surgeon, for an instrument or truss for nicking horses' tails.—July 19.

Wheels.—J Pearse, Tavistock, Devon, ironmonger, for improvements in the construction of wheels.—July 19.

Cranes.—J. H. Hitchin, and R. Oram, Salford, Lancaster, engineers, for improvements in cranes, for lifting and removing goods.—July 19.

Vessels.—J. P. Drake, Arundel-street, Strand, Middlesex, artist, for improvements in building ships, steam-vessels and boats, barges and lighters.—July 19.

Locomotive Engines.—Sir J. C. Anderson, Buttevant Castle, York, Bart., for improvements in locomotive engines.—July 19.

Flax and Hemp.—H. Goschen, Crosby-square, Bishopsgate-street, London, merchant, for improvements in preparing flax and hemp for spinning, (*for*)—July 19.

Candle-making.—J. H. Tuck, Rainbow, Tavern, London, gentleman, for improvements in machinery for making candles.—July 25.

Railways.—J. Melling, Liverpool, Lancaster, engineer, for improve-

ments in locomotive steam-engines upon railways, also applicable to stationary steam-engines.—July 26.

Paper-Hangings.—W. Palmer, Sutton-street, Clerkenwell, manufacturer, for improvements in printing paper-hangings.—July 29.

Block-Printing.—J. Matley, Paris, and of Manchester, Lancaster, gentleman, for "a tiering-machine," for supplying colours in block-printing.—Aug. 2.

Manuring Land.—A. R. F. Rosser, New Boswell-court, Middlesex, Esq., for improvements in preparing manure, (*for.*)—Aug. 2.

Teas.—A. Macewan, grocer and tea-merchant, Glasgow, for a process for the improvement of teas.—Aug. 5.

Mechanical Power.—R. T. Beck, Little Stoneham, Suffolk, gentleman, for new or improved apparatus for obtaining power, (*for.*)—Aug. 9.

Alkali Manufacture.—W. Gossage, Stoke Prior, Worcester, manufacturing chemist, for improvements in the manufacture of alkali from common salt.—Aug. 17.

Steam-engines.—W. Gilman, Bethnal-green, Middlesex, engineer, for improvements in steam-boilers and engines.—Aug. 17.

Pin-making.—H. Shuttleworth, Market Harborough, Leicester, gentleman, and D. F. Tayler, Woodchester, Gloucester, pin manufacturer, for improvements in machinery for making pins, being an extension of an invention for the term of five years.—Aug. 21.

Multiplying Power.—J. G. Hartley, No. 11, Beaumont-row, Mile End-road, Middlesex, Esq., for an improved application of levers for multiplying power.—Aug. 22.

Malting.—T. Du-Boulay, Sandgate, Kent, Esq., and J. J. C. Sheridan, Lewisham, in the same county, Esq., for improvements in drying and screening malt.—Aug. 24.

Water-closets.—J. Crellier, Liverpool, Lancaster, and J. Holt, of the same place, plumber, for improvements in water-closets.—Aug. 24.

Drying Hops.—R. Brown, Maidstone, Kent, engineer and iron founder, for improvements in the construction of cockles, stoves, or apparatus for drying hops, malt, grain or seeds.—Aug. 24.

Boilers.—W. Hearn, Southampton-street, Pentonville, Middlesex, engineer, and William Davies, of Upper North-place, Gray's Inn-road, Middlesex, plumber, for improvements in the construction of boilers for generating steam and heating water.—Aug. 24.

Piano-fortes.—W. Southwell, No. 5, Winchester-row, New-road, Middlesex, piano-forte maker, for an improvement in piano-fortes.—Aug. 24.

Ploughs.—W. Armstrong, jun., Hawness, Bedford, farmer, for improvements in ploughs.—Aug. 28.

Soda.—J. J. C. Sheridan, Ironmonger-lane, London, chemist, for improvements in the manufacture of soda.—Aug. 31.

Pipes.—J. Hanson, Huddersfield, York, leaden pipe manufacturer, and C. Hanson, of the same place, watchmaker, for improvements in machinery for making metallic and other pipes, tubes, &c.—Aug. 31.

Furnaces.—J. Neville, Clap Hall near Gravesend, Kent, civil engineer, for a furnace for economizing fuel, and for consuming the smoke, applicable for the generation of steam, and heating or evaporating fluids.—Aug. 31.

Paddle Wheels.—W. J. Gifford, Gloucester-place, Middlesex, surgeon, for improvements in paddle wheels.—Sept. 7.

Ships' Masts.—H. V. Huntley, Great Russell-street, Middlesex, Lieut.,

R. N., for improvements in apparatus for securing of ships' masts.—Sept. 7.

Paddle Wheels—T. J. Cave, Rodney-street, Pentonville, Middlesex, gentleman, for an improvement in the construction of paddle wheels.—Sept. 14.

Paper-making.—E. Shaw, Fenchurch-street, London, stationer, for an improvement in the manufacture of paper by a vegetable substance not hitherto used for that purpose, (*for.*)—Sept. 14.

Earthenware Tile.—R. Davies, Newcastle-upon-Tyne, and R. C. Wilson, Gateshead, Durham, earthenware manufacturers, for an earthenware tile, slab, or plate.—Sept. 14.

Brick-making.—N. Smart, Bridge Wharf, Hampstead-road, Middlesex, wharfinger, for improvements in making bricks.—Sept. 21.

Raising Water.—S. Cowling, Bowling, Bradford, York, barber, for improvements in raising water.—Sept. 21.

Steam Boiler.—W. J. Curtis, Deptford, Kent, engineer, for an improved boiler for generating steam.—Sept. 21.

Steam-engines.—T. S. Mackintosh, Coleman-street, London, engineer, and W. A. Robertson, Islington, Middlesex, gentleman, for improvements in steam engines.—Sept. 28.

Sugar-making.—F. Hoard, Demerara, now of Liverpool, Esq., for improvements in making sugar.—Sept. 30.

Steam-engines.—J. Dickson, of Charlotte-street, Blackfriars-road, engineer, for improvements in steam engines and in generating steam.—Sept. 30.

Sulphuric Acid.—T. Clark, M.D., professor of Chemistry, in Marischal College, Aberdeen, for improved apparatus in manufacturing sulphuric acid.—Sept. 30.

Working Metals.—J. Whitworth, Manchester, Lancaster, engineer, for improvements in machinery, tools, or apparatus for turning, boring, planing, and cutting metals.—Oct. 5.

Sluice Cocks.—O. Topham, White Cross-street, Middlesex, engineer and millwright, for improvements in sluice cocks for water-works, also applicable to steam, gas, &c.—Oct. 5.

Roller Blinds.—J. Loach, Birmingham, Warwick, brass founder, for improvements in roller blind furniture.—Oct. 5.

Brandy.—J. T. Betts, Smithfield Bars, London, rectifier, for improvements in making of brandy, (*for.*)—Oct. 5.

Steam-engines.—A. P. De Rigel, Vienna, now of Beaufort-buildings, Strand, Middlesex, engineer, for improvements in steam engines.—Oct. 14.

Farming.—T. Vaux, Woodford, Essex, land surveyor, for improvements in tilling and fertilizing land.—Oct. 14.

Gas-Lighting.—H. Q. Tenneron, late of Paris, now of Leicester-square, Middlesex, gentleman, for improved vessels for portable gas, and of the apparatus for compressing gas therein, regulating the supply of gas, (*for.*)—Sept. 19.

Iron Manufacture.—E. F. J. Duclos, late of Samson, Belgium, now of Church, Lancaster, gentleman, for improvements in manufacturing iron.—Oct. 20.

Canal Vessels.—H. R. Palmer, Great George-street, Westminster, civil engineer, for improvements in giving motion to vessels on canals.—Oct. 20.

Harps.—J. F. Grosjean, Soho-square, Middlesex, musical instrument

maker, for improvements on harps and other musical stringed instruments.—Oct. 20.

Palm Oil—M. Berry, Chancery-lane, Middlesex, civil engineer, for improvements in the preparation of palm oil for woollen manufactures, machinery, &c., (*for.*)—Oct. 26.

Dressing Hemp.—M. Berry, Chancery-lane, as aforesaid, for improvements in machinery for heckling or combing hemp, and other fibrous substances, (*for.*)—Oct. 26.

Locomotive Engines.—J. Whitworth, Manchester, Lancaster, engineer, for improvements in locomotive and other steam-engines.—Nov. 2.

Coal Gas.—R. Burch, Heywood, Lancaster, engineer, for improvements in manufacturing gas from coal.—Nov. 2.

Block-Printing.—J. Lockett, Manchester, Lancaster, engraver, for improvements in printing cotton, silk, wool, paper, or linen, (*for.*)—Nov. 2.

Timekeepers.—J. Gowland, Leathersellers'-buildings, London, watch and chronometer maker, for an improvement in the mechanism of timekeepers.—Nov. 2.

Carriage Springs.—R. J. Tremonger, Wherwell, Hampshire, Esq., for an improved spring for wheel carriages.—Nov. 4.

Steam-Plough.—J. Upton, New-street, Southwark-bridge, Surrey, engineer, for applying steam power to ploughing, harrowing, and other agricultural purposes.—Nov. 4.

Porous Vessels.—E. A. Ortman, Stockholm, Sweden, now of Ebenezer-place, Limehouse, Middlesex, for freeing porous vessels from substances which they are liable to absorb.—Nov. 4.

Ammoniacal Salts.—G. D. Midgley, Strand, Middlesex, chemist, and J. H. Kyan, Cheltenham, Gloucester, Esq., for an improved mode of extracting ammoniacal salts from liquor produced in the manufacture of coal gas. Nov. 4.

Spinning.—W. Arthur, Glasgow, North Britain, machine maker, for improvements in spinning fibrous substances.—Nov. 4.

Smoke—T. Michell, Kingsland-green, Middlesex, gentleman, for improvements in washing or purifying smoke.—Nov. 7.

Stocks.—T. Hughes, High Holborn, Middlesex, truss maker, for an improvement in stocks, cravats, or stiffners.—Nov. 7.

Working Wood.—C. F. E. Aulas, 38, Grande Rue Verte, Paris, now of Cockspur-street, Middlesex, gentleman, for a method of cutting and working wood by machinery, (*for.*)—Nov. 7.

Protective Paper.—C. F. E. Aulas, as aforesaid, for improvements in preparing writing paper so as to prevent the discharge of the ink therefrom without detection, and to prevent the falsification of writing thereon, (*for.*)—Nov. 7.

Cotton Spinning.—J. Potter, Ancoats, Manchester, Lancaster, cotton-spinner, for improvements in preparing warps for the loom.—Nov. 9.

Steam-engine.—J. Slater, Salford, Lancaster, gentleman, for improvements in steam engines, boilers, and furnaces.—Nov. 9.

Peat Moss.—C. W. Williams, Liverpool, Lancaster, gentleman, for improvements in preparing peat-moss, for fuel, &c.—Nov. 11.

Beet-root Sugar.—H. Crosley, Hooper-square, Middlesex, civil engineer, for improved manufacture of sugar from beet-root, and other vegetable substances, (*for.*)—Nov. 11.

Pulleys.—H. Stansfield, Leeds, York, merchant, for a tappet and

lever action to produce a vertical or horizontal movement through pulleys, (*for*)—Nov. 14.

Gunnery.—W. Coles, Charing-cross, Middlesex, Esq., for improvements in gunnery.—Nov. 14.

Lace-making.—R. White, Nottingham, lace-maker, for improvements in ornamental lace.—Nov. 14.

Writing Ink.—R. Whitfield, Hercules-buildings, Westminster-road, Surrey, gentleman, for an "indelible safety and durable black fluid writing ink."—Nov. 14.

Umbrellas.—J. J. Rubery, Birmingham, Warwick, umbrella manufactuer, for improvements in the furniture of an umbrella, (*for.*)—Nov. 14.

Frame-work Knitting. —J. B Mather, Nottingham, mechanic, for improvements in machinery for manufacturing hosiery goods, or frame-work knitting.—Nov. 14.

Glass-making.—W. N. Clay, West Bromwich, Stafford, manufacturing chemist, and D. Smith, St. Thomas's Hospital, Southwark, for improvements in the manufacture of glass.—Nov. 16.

Tanning.—W. Herapath, Bristol, Somerset, and J. F. Cox, of the same place, tanner, for improvements in tanning.—Nov. 16.

Ventilating.—W. Fourness, Leeds, York, painter, for improvements in ventilating pits, shafts, mines, wells, ships' holds, &c.—Nov. 16.

Ventilating.—J. Buckingham, Miners' Hall, Strand, Middlesex, civil engineer, for improvements in ventilating mines, ships, &c.—Nov. 16.

Carding-engines.—T. Birch, Manchester, Lancaster, machine maker, for improvements in carding engines.—Nov. 18.

Raising Fluids.—E H. Collier, Globe Dock Factory, Rotherhithe, for improvements in machinery for raising fluids.—Nov. 21.

Embossing.—C. Nickels, Guildford-street, Lambeth, Surrey, gentleman, for improvements in embossing leather, &c.—Nov. 21.

Locomotive Engines.—E. Wylde, Birmingham, Warwick, engineer, for improvements in locomotive and other engines.—Nov. 21.

Block-Printing.—J. Matley, Paris, and of Manchester, Lancaster, gentleman, for improvements in machinery for tiering in block printing.—Nov. 23.

Rice.—J. J. Cordes, Idol-lane, London, merchant, for an improved mortar for dressing raugh or paddy, or redressing rice.—Nov. 25.

Rail-roads.—H. P. Vaile, Oxford-street, Middlesex, civil engineer, for improvements in rails for rail-roads.—Nov. 25.

Cement.—R. T. Claridge, Salisbury-street, Strand, Middlesex, gentleman, for a mastic cement for paving and road-making, covering buildings, &c., (*for.*)—Nov. 25.

Needle making.—S. Cocker, Porter Works, Sheffield, York, manufacturer, for improvements in making needles.—Nov. 25.

Frame-work Knitting.—T. Moore, Ison Green, Nottingham, lace manufacturer, for improvements in machinery for frame-work knitting.—Nov. 27.

Lace-making.—S. Draper, Bradford, Nottingham, lace-maker, for improvements for producing ornamental lace or weavings.—Nov. 27.

Filtration.—J. Dover, Thames-street, merchant, and W. Jones, Bartholomew-close, chemist, London, for improvements in filtering fluids.—Nov. 28.

Boots and Shoes.—J. Dowie, Frederick-street, Edinburgh, boot and shoe maker, for improvements in the construction of boots and shoes.—Dec. 2.

Metal Pipes.—W. Occleshaw, Manchester, Lancaster, leaden pipe manufacturer, for improvements in the machinery for manufacturing metallic pipes.—Dec. 2.

Coating Iron.—T. W. Booker, Merlin Griffith Works, Glamorganshire, iron master, for improvements in preparing iron to be coated with tin, &c. —Dec. 4.

Carriage Wheels.—G. Cottam, Winsley-street, Oxford-street, Middlesex, engineer, for improvements in wheels for railway and other carriages.—Dec. 5.

Looms.—M. Poole, Patent Office, Lincoln's-inn, Middlesex, gentleman, for improvements in looms for weaving figured fabrics, &c., (*for.*)—Dec. 5.

Printing.—M. Poole, as aforesaid, for improvements in printing, (*for.*) —Dec. 5.

Drying Cloth.—J. Hall, Nottingham, lace manufacturer, for improvements in machinery for stretching and drying woven fabrics.—Dec. 5.

Beale's Lamp.—J. T. Beale, Church-lane, Whitechapel, Middlesex, engineer, for improvements in, and additions to, his new patent lamp.—Feb. 4.

Rolling Metals.—S. Mills, Darlaston Green, iron and steel works, Wednesbury, for improvements in machinery for rolling metals.—Dec. 9.

Lamps—J. Bynner, Birmingham, Warwick, lamp manufacturer, for improvements in lamps.—Dec. 9.

Gas-Burners.—B. Cook, Birmingham, Warwick, brass founder, for improvement in gas burners.—Dec. 9.

Drums.—C. Ward, Great Tichfield street, Mary-le-bone, Middlesex, musical instrument maker, for improvements in drums.—Dec. 9.

Hinges.—T. Vale, Allen-street, Lambeth, Surrey, coach joiner, for improvements in hinges.—Dec. 13.

Boring Stones.—J. Hunter, Ley's Mill, Arbroath, Forfar, Mechanic, for a machine for boring stones—Dec. 13.

Buttons.—W. Elliott, Birmingham, Warwick, button manufacturer, for improvements in covered buttons,—Dec. 14.

Heating.—T. Joyce, Camberwell New Road, Surrey, gardener, for improved apparatus for heating buildings, and for improved fuel.—Dec. 16.

Preserving.—J. J. L. Margary, Wellington-road, St. John's Wood, Middlesex, Esq., for a new mode of preserving animal and vegetable substances.—Dec 19.

Steam-engines.—J. Gray, Liverpool, Lancaster, engineer, for improvements in Steam-engines, particularly applicable to marine engines for propelling vessels—Dec. 19.

Railway Carriages.—E. B. Rowley, Charlton-upon-Wedlake, Manchester, Lancaster, surgeon, for improvements in locomotive engines, tenders, and carriages, upon railways. Dec. 19.

Smokey Chimneys.—J. Berington, Winkworth-place, Shoreditch, gentleman, and N. Richards, Camomile-street, London, builder, for improvements in curing or preventing smokey chimneys.—Dec. 19.

Lathes.—J. White, Manchester, Lancaster, engineer, for improvements in lathes.—Dec. 19.

Docks.—W. H. Pitcher, West India Dock House, Billiter Street, Middlesex, merchant, for improvements in docks.—Dec. 19.

Building.—J. Robertson, jun., Great Charlotte-street, Buckingham-gate, Middlesex, gentleman, for improvements in architecture, protecting buildings from decay, and giving them a more finished appearance.—Dec. 19.

Book-binding.—C. Nickels, Guildford-street, Lambeth, Surrey, gentleman, and H. G. Collins, Queen street, Cheapside, London, bookbinder, for improvements in bookbinding.—Dec. 19.

Iron Manufacture.—N. Clay, West Bromwich, Stafford, manufacturing chemist, for improvements in the manufacture of iron.—Dec. 19.

Paddle-wheels.—W. S Hall, Streatham Cottage, Chelsea, Lieut., for improvements in paddle-wheels.—Dec. 19.

Telegraphs.—W. H. James, Birmingham, Warwick, civil engineer, for improvements in telegraphic apparatus.—Dec. 22.

White Lead.—C. Button, Holborn-bars, chemist, and H. G Dyar, Mortimer-street, Cavendish-square, gentleman, Middlesex, for improvements in the manufacture of white lead.—Dec. 23.

Presses.—W. Brindley, Birmingham, Warwick, patent paper tray manufacturer, for improvements in the construction of presses.—Dec. 23.

Salt.—W. Losh, Benton Hall, Northumberland, Esq., for improvements in decomposing muriate of soda, (common salt.)—Dec. 23.

Stoves.—J. F. Norton, Manchester, merchant, for improvements on stoves or furnaces, (*for*)—Dec. 23.

Paddle-wheels.—J. Elvey, Canterbury, Kent, millwright, for improvements in paddle-wheels.—Dec. 23.

SCIENTIFIC BOOKS PUBLISHED IN 1837.

Adams (W. B.) on English Pleasure Carriages.—Anatomical Remembrancer; or, Pocket Anatomist.—Aræteus on Causes and Signs of Disease, transl. by Reynolds.—Arnott's Elements of Physic in Spanish, vols. 1 and 2.—Babbage's Ninth Bridgewater Treatise.—Bachhoffner's Chemistry as applied to the Fine Arts.—Bardwell on Ancient and Modern Temples.—Barton and Castle's British Flora Medica, vol. 1.—Bateman's Orchidaceæ of Mexico, &c., part 1.—Belinaye's Compendium of Lithotripsy.—Bell's (Thos.) History of British Quadrupeds.—Bell's (Sir C.) Institutes of Surgery, vol. 1.—Bennett's (John) Geometrical Illustrations.—Bennett's (John) Millwright and Engineer's Director.—Book of Shells.—Book of Trees.—Brewster's Treatise on Magnetism.—Brewster's Treatise on the Microscope.—British Annual, and Epitome of Science for 1838.—British Association, Sixth Report (Bristol.)—British Cyclopædia, complete.—Burton's (F. B.) Distant Glimpses; or, Astronomical Sketches.—Bushnan's Philosophy of Instinct and Reason.—Caveler's Specimen's of Gothic Architecture.—Curie's Principles of Homœopathy.—Dick's Celestial Scenery.—Edinburgh Dissector; or, System of Practical Anatomy.—Elements of Botany.—Elliotson's Human Physiology, part 2.—Fairholme's Geology of the Mosaic Deluge.—Fleming's Molluscous Animals, including Shell Fish.—Fletcher's Young Astronomer.—Forbes' Horticultural Tour through Germany, Belgium, &c.—Francis' Analysis of British Ferns and their Allies.—Gall's (Dr.) Phrenological Works.—Gill's Treatise on the Teeth of Wheels, &c.—Girtin's Illustrations of Structure, &c of the Human Body.—Gould's Birds of Australia, &c., part I.—Gould's Synopsis of Ditto, parts I & 2.—Gwilt's Elements of Architectural Criticism.—Hebert's Treatise on Railroads and Locomotion.—Hebert's Engineer's, &c., Encyclopædia.—Herbert's (Hon. W.) Treatise on Bulbous Roots.—Higgins's Hand-Book of Natural Philosophy.—Hood's (Chas.) Treatise on Warming Buildings by Hot Water.—Hunter's (John) Animal Economy, by R. Owen.—Hutchi-

son's Essays on unexplained Phenomena.—Hymers's Treatise on Algebraical Equations.—Hymers's Treatise on Conic Sections.—Jamieson's (Dr. A.) Mechanics of Fluids for Practical Men.—Jamieson's Mechanics for Practical Men.—Jardine's Naturalist's Library, vols. 17—20.—Jardine and Selby's Ornithology.—Keith's Botanical Lexicon of Vegetable Physiology.—Krusenstern's Atlas de l'Ocean Pacifique.—Lambert and Don's Genus Pinus.—Leithead's Nature, Operation, &c. of Electricity.—Liebig's First Elements of Chemistry, transl. by Richardson.—Lindley's Ladies' Botany, vol. 2.—Logarithmic and Trigonometric Tables (Decimals.)—MacClelland's Geology, &c of the Province of Kemaon.—Macfaleyn's Flora of Jamaica, part I.—Macgillivray's History of British Birds, vol. 1.—Magazine of Popular Science, &c.—Muller's Physiology of Man, transl. by Bayly.—Nichol's Views of the Architecture of the Heavens.—Ottley's Treatise of the Differential Calculus.—Parker's (G. F.) New and Original Lunar Tables.—Perkins's Elements of Botany.—Phillips' (John) Treatise on Geology, (from Ency. Brit.)—Philosophical Transactions for 1836 and 1837, parts 1 and 2.—Pratt's (J. H.) Principles of Mechanical Philosophy.—Railway Practice.—Reid's (Hugh) Chemistry of Nature.—Rhind's Elements of Geology.—Richardson's Treatise on the Warming, &c. of Buildings.—Richardson's (John) Zoology of N. Amer., (Insects.)—Runge's Chemistry of Dyeing, part 1. Shuckard's Essay on Indigenous Fossorial Hymenoptera.—Sillig's Dictionary of the Arts of Antiquity.—Silliman's Consistency of Geology and Scripture.—Smellie's Philosophy of Natural History.—Steggall's Chemical Decompositions of the L. Pharmacopeia.—Transactions of the Entomological Society, part 3.—Geological Society, vol. 5, part 1. —Linnæan Society, vol. 17, part 4.—Philosophical and Literary Society of Leeds, vol. I, part I.—Royal Irish Academy, vol. 17.—Royal Society of Edinburgh, vol. 13, part 2.—Statistical Society of London, vol. I, part I.—Vicat on Mortars and Cements, transl. by Capt. Smith. —Walker's Philosophy of the Eye.—Wallace's (Wm.) Geometrical Treatise on the Conic Sections.—Watson's (H. C.) Botanist's Guide, vol. 2, (Scotland, &c.)—Webster's (T.) Elements of Physic.—Whewell's History of the Inductive Sciences.—Whewell's Mechanical Euclid. —Whishaw's Analysis of Railways.—Zoological Society (Proceedings of,) 1836, part 4.

OBITUARY OF PERSONS EMINENT IN SCIENCE AND ART, 1837.

Dr. Edward Turner, F.R.S., Professor of Chemistry at the London University. His *Elements of Chemistry* have enjoyed an uncommon degree of popularity, and are remarkable for clearness and precision, both in the description of his experiments, and in the deduction of his theory.

Dr. William Ritchie, F.R.S., Professor of Natural Philosophy at the London University, "an experimenter of great ingenuity and merit."

Mr. J. D. Broughton, F.R.S., an eminent Physiologist.

Dr. Adam Afzelius, Professor of Materia Medica and Dietetics, at Upsala; one of the last surviving pupils of Linnæus, and a Botanist of great learning and acquirements.

Professor Morichini, of Rome, chiefly known for his experiment on the magnetizing influence of the violet rays in the solar spectrum, doubted

by Configliachi and Berard, but verified by our justly celebrated countrywoman, Mrs. Somerville.

Edward Turner Bennett, Esq., successively Secretary to the Zoological Club, the Linnæan Society, and the Zoological Society. "His duties were performed with such zeal, talent, and extensive information, as can never be forgotten by those who had the opportunity of watching his labours, and of acting with him. His published works are not, perhaps, equivalent in importance to his deservedly high character as a naturalist. His knowledge of zoological literature was even, perhaps, more extensive than that of any other person in this country."

Thos. Ball, Esq., F.R.S.

Dr. Tiarks, F.R.S., a very careful and efficient practical Astronomer.

Dr. James Woodroffe, of Castle Carey, Somerset, Botanist.

Joseph Sparshall, Esq., F.L.S., a well-known practical Entomologist.

Mr. C. L. Nitsch, Professor of Natural History in the University of Halle; a distinguished Entomologist and Ornithologist.

Henry Adolph Schrader, Professor of Botany, at Gottingen; author of the celebrated *Flora Germanica*.

Robert John Thornton, M.D., the celebrated Botanist.

Thos. Henry Colebrooke, Esq., F.R.S., one of the most distinguished Oriental Scholars of Europe, and as eminent for his scientific ardour.

Mr. Edward Donovan, F.L.S., author of various splendidly illustrated works on the Zoology of this country, and on the Insects of India and New Holland.

John Latham, M.D., F.R.S., Father of the Royal and Antiquarian Societies, and one of the original Members of the Linnæan Society, who devoted himself to his favourite science of Ornithology to the close of his life, extended to his 96th year. His great works are, *Index Ornithologicus*, 2 vols 4to. 1790; and *A General History of Birds*, 10 vols. 4to. 1821–1824.

Joseph Sabine, Esq., F.R.S., forty years a Fellow of the Linnæan Society; and Secretary to the Horticultural Society at its first establishment, to whose Transactions he contributed sixty-four papers. Mr. Sabine was likewise an active and valuable member of the Zoological Society.

Mr. John Hay, of Edinburgh, Garden-Architect.

John Linnell Bond, Esq., Architect, who designed Waterloo Bridge, and made all the necessary estimates for the projector, the late Mr. George Dodd, engineer.

Fontana, the celebrated Engraver.

Dr. Uwins, author of Treatises on Indigestion, the Brain, Nervous System &c.

Dr Lloyd, Provost of Trinity College, Dublin, who was President of the British Association at their meeting in 1835.

Barron Alibert, the celebrated Parisian Physician.

William Daniell, Esq., R.A.

Captain William Mudge, R.N., an officer of the highest attainments and scientific skill, who conducted for five or six years the Nautical Survey of Ireland, now in progress.

Viscount Kingsborough, Antiquarian.

H. Storer, Architectural draughtsman and Engraver.

John Constable, R.A.

W. Woolnoth, Engraver.

Van Hool, Sculptor, Antwerp.

Aloysius Hirt, Archæology and Architecture, Berlin.

CALENDAR OF THE MEETINGS OF THE SCIENTIFIC BODIES OF LONDON FOR 1837-8.

SOCIETIES.	Times of Meeting.	November	December.	January.	February.	March.	April. East. S. 15th	May.	June. Whit. Sund. 3rd	SOCIETIES.
Royal......	Thu. 8½ P.M.	16, 23, 30*	7, 14, 21	11, 18, 25	1, 8, 15, 22	1, 8, 15, 22, 29	5, 26	3, 10, 17, 24, 31	14, 21	Royal
Antiquaries.	Thu. 8 P.M.	16, 23, 30	7, 14, 21	11, 18, 25	1, 8, 15, 22	1, 8, 15, 22, 29	5, 23*	3, 10, 17, 24, 31	14, 21	Antiquaries
Linnæan....	Tues. 8 P.M.	7, 21	5, 19	16	6, 20	6, 20	3, 17	1, 24*	5, 19	Linnæan
Horticult.	Tues. 3 P.M.	7	5	16	6, 20	6, 20	3, 17	1*, 15	5, 19	Horticul.
	Nov. Dec. Jan	—	—	—	—	—	—	—	—	
	Feb. 2, P.M.	—	—	—	—	—	—	—	—	
R. Med. & Chi.	Tues. 8½ P.M.	14, 28	12	9, 33	13, 27	1*, 13, 27	10, 24	8, 22	—	Med. & Chir.
Civil Engin.	Tues. 8 P.M.	—	—	9, 16*, 23, 30	6, 13, 20, 27	6, 13, 20, 27	3, 10, 24	1, 8, 15, 22, 29	—	Civil Engin.
Zoological.	Tues. 8½ P.M.	14, 28	12, 26	9, 23	13, 27	13, 27	10, 24	8, 22	12, 26	Zoological
	Thurs. 3 P.M.	2	7	4	1	1	5, 30*	3	7	
So. of Arts.	Wed. 7½ P.M.	1, 8, 15, 22, 29	6, 13, 20	10, 17, 24, 31	7, 14, 21, 28	7, 14, 21, 28	4, 11, 18, 25	2, 9, 16, 23, 30	6, 13	Soc. of Arts
	Illustr. Tues.	14	12	9	13	13	10	8	12	
Geological...	Wed. 8½ P.M.	1, 15, 29	13	3, 17, 31	16*, 21	7, 21	4, 25	9, 23	6	Geological
Lond. Instit..	Wed. 7 P.M.	—	—	—	—	7, 21	4, 18, 26*	—	—	Lond. Instit.
Graphic.....	Wed. 8 P.M.	—	—	10	14	14	11	9	13	Graphic
Med.-Botan..	Wed. 8 P.M.	8, 22	13	10, 16*, 24	14, 28	14, 28	25	9, 23	13, 27	Med.-Bot.
R. S. Literat.	Thurs. 4 P.M.	23	14, 28	11, 25	8, 22	8, 22	12, 26*	10, 24	14, 28	Literature
Numismatic.	Thurs. 7 P.M.	16	14	18	15	15	26	24	21*	Numismatic
R. Astronom.	Frid. 8 P.M.	10	8	12	9*	9	11 (Wed.)	11	8	Astronomy
R Institution.	Frid. 8½ P.M.	—	—	19, 26	2, 9, 16, 23	2, 9, 16, 23, 30	6, 27	1*, 4, 11, 18, 25	1, 8	R. Institut.
Ornitholog...	Frid. 3 P.M.	3	1	5	2	2	6	4, 26*	1	Ornitholog.
Royal Asiatic	Sat 2 P.M.	—	2, 16	6, 20	3, 17	3, 17	7, 21	12*	16; July 7, 21	Asiatic
R. Geograph	Mond. 9 P.M.	13, 27	11	8, 22	12, 26	12, 26	9, 23	14, 21*, 28	11, 25	Geograph.
Entomolog...	Mond 8 P.M.	6	4	1, 22*	5	5	2	7	4	Entomolog.
Statistical...	Mond. 8 P.M.	20	18	15	19	15*, 19	16	14	18	Statistical.
Brit Archit.	Mond. 8 P.M.	—	4, 18	15, 29	12, 26	12, 26	9, 23	7*, 21	11, 25; July 9, 23	Architects.

British Museum: The Reading Room is open to persons, having tickets of admission, every day except Sundays, and at the times above-mentioned when the Museum is closed, from 9 till 7 in May, June, July, and August, and from 9 till 4 during the rest of the year. The Gallery of Antiquities is open to students having tickets every day in the week, except Saturdays and Sundays, (and those times when the Museum is closed,) at the same hours as the Reading Room.—*Royal College of Surgeons*: The Museum is open every Monday, Wednesday, and Friday, from 12 till 4. The Library is open daily from 10 till 4; and a Reading Room is open every Tuesday, Wednesday, and Thursday, from 7 till 10 in the Evening.—*Geological Society*: The Library and Museums are open every day from 11 till 5.—*Royal Asiatic Society*. The Museum is open every Tuesday, Wednesday, and Thursday, from 11 till 4.—*Zoological Society*: The Meetings are continued throughout the year; for General Business on the first Thursday, and for Scientific Business on the second and fourth Tuesdays of each Month.—*Entomological Society*: The Meetings are continued throughout the year, on the first Monday of each Month. The Museum is open every Tuesday from 12 till 4.

INDEX.

MECHANICAL INVENTIONS.

CHEMICAL SCIENCE.

NATURAL HISTORY.

ZOOLOGY.

BOTANY.

GEOLOGY.

ASTRONOMICAL AND METEOROLOGICAL PHENOMENA.

RURAL ECONOMY.

GARDENING.

USEFUL ARTS.

MISCELLANIES.

Printed by J. Limbird, 143, Strand.

UNIFORM WITH THE PRESENT VOLUME,

WITH MANY CUTS, price 5s.

ARCANA OF SCIENCE AND ART

FOR THE YEAR 1837.

Among the most important Papers in this Volume are—

Mechanical Science.—State of the London and Birmingham Railway; the progress of the Thames Tunnel, Captain Brown's proposed Metallic Light-houses, Steam Communication with India [illegible] Traction on Canals, the economy of Steam-boilers; the Dublin and Kingstown Railway, Steam applied to Agriculture; Mr. Rowland Hill's Rotatory Printing Machine, a new Safety Spring for Carriages and Carts, Professor Whewell on the Tides, Iron Suspension Bridge in India, the Theory of Railways, by Dr Lardner, description of the Greenwich Railway, and Arnold and Dent's Balance-springs for Chronometers.

Chemical Science.—Experiments with Drummond's Light for Lighthouses in the Black Sea; Dr T. Thomson on Sulphuric Acid, Dr Ure's Patent Sugar-pan, M. Boussingault on Bitumens, on Fluorine, by the Messrs. Knox, Professor Faraday on the Magnetic Relation of the Metals, action of Isinglass in clearing Malt Liquor, Dr. Ritchie's Researches in Electricity and Magnetism, Professor Davy on Carburet of Potassium, and a new Gaseous Bicarburet of Hydrogen, Mrs Somerville on the Chemical Rays of the Solar Spectrum, New Metal called Donium, Berzelius on a New Power which acts in the Formation of Organic Bodies, Dr Hall's New Thermometer; Dr. Thomas Thomson's Chemical Analysis of Tabasheer, Professor Faraday on Silification; a valuable method of Detecting Arsenic, Mr Crosse's Artificial Crystals and Minerals, Dobereiner on New Combinations of Platinum, Professor Daniell on Voltaic Combinations; Mr R. W Fox on Galvanic Changes in the Chemical Character of Metals; Thebaia, a New Alkali in Opium, Magnetic Experiments in an Iron Steam-boat, and Dr. Gregory on Caoutchoucine

In *Zoology* are Notices of New Species or rarely described Specimens,—as the Harvest Bug, a new British Fish, the Long-eared Bat; Gordius Aquaticus; Changes in Crabs: Nests of the Wasp, papers on the Zoology of Boothia and North America; and Professor Ehrenberg's New Discovery in Palæontology—Tripoli composed wholly of Infusorial Exuviæ; the most striking facts in the proceedings of the Zoological Society.

In *Botany* is a paper on the Colour of the Leaves and Flowers of Plants; Growth of Wheat; notice of Sugar-candy in Flowers, and Boiling Seeds, and a paper on Fossil Ferns.

In *Geology*, Mr Charlesworth on the Vertebrated Animals of the Crag of Norfolk and Suffolk; Cobalt at Paris, Phenomenon of Elevation; Blocks or Boulders in the North of England, Gas in Coal Mines; two undescribed Radiaria; Messrs Sedgwick and Murchison on the Old Slate Rocks of Devon, Professor Ehrenberg on Fossil Infusoria; the Ichthyosaurus, by Sir Philip G. Egerton, and a paper descriptive of some recently found Fossils in the London Clay.

Among the *Astronomical and Meteorological* Phenomena are notices of the Annular Eclipse of the Sun, and a Meteorological Summary of the year, by Dr. Armstrong.

The most valuable facts elicited at the anniversary of the British Association for the Advancement of Science, will be found condensed in each of the preceding divisions.

JOHN LIMBIRD, 143, STRAND.